TIMBER SUPPLY BRANCH

TIMBER SUPPLY REVIEW

Prince George Timber Supply Area Analysis Report

September 2001

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Prince George Timber Supply Area Analysis Report

British Columbia Ministry of Forests
595 Pandora Avenue
Victoria, B.C.
V8W 9C3

September 2001

National Library of Canada Cataloguing in Publication Data
Main entry under title:
Prince George timber supply area analysis report

Includes bibliographical references: p.
ISBN 0-7726-4610-4

1. Timber – British Columbia – Prince George Region. 2. Forests and forestry - British Columbia – Prince George Region – Mensuration. 3. Forest management – British Columbia – Prince George Region. 4. Prince George Forest Region (B.C.). I. British Columbia. Ministry of Forests.

SD438.B7P74 2001 333.75'11'097182 C2001-960230-8

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Preface

This report contains a timber supply analysis and socio-economic analysis and is part of the provincial Timber Supply Review carried out by the British Columbia Forest Service. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) and tree farm licences (TFLs) throughout British Columbia.

To determine allowable timber harvesting levels, the chief forester must have an up-to-date assessment of the timber supply based on the best available information and reflecting current management direction. **The report that follows provides this assessment but should not be construed as a recommendation on permissible harvest levels.**

This report focuses on a single forest management scenario — current management practices. Current management practices are defined by the specifications in management plans for the timber supply area including guidelines for the protection of forest resources, the *Forest Practices Code (FPC) of British Columbia Act* and official land-use decisions made by Cabinet.

Focusing the assessment on the implications of current practices rather than looking at a number of different management schemes expedites the analysis process, allowing analysis of all TSAs in the province every five years. An important part of these analyses is an assessment of how results might be affected by uncertainties — a process called sensitivity analysis. Together, the sensitivity analyses and the assessment of the effects of current forest management on the timber supply form a solid basis for discussions among stakeholders about alternative timber harvesting levels.

In addition to having an up-to-date assessment of timber supply when setting the allowable annual cut (AAC) the chief forester considers short- and long-term implications of alternative harvest levels, capabilities and requirements of existing and proposed processing facilities, and the social and economic objectives of the Crown. The socio-economic analysis provides the chief forester with some of the information necessary for these considerations.

This report is the third of five documents that will be released for each TSA as part of the Timber Supply Review. (The first two documents are the information report and the data package). A fourth document called the public discussion paper will summarize the technical information and will provide a focus for public discussions of possible timber harvest levels. The fifth will outline the chief forester's harvest level decision and the reasoning behind it.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in Prince George Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over the short- (next 20 years), medium- (21 years to 170 years from the present) and long- (beyond 170 years from the present) terms. It also examines the potential changes in timber supply stemming from uncertainties about forest growth and management actions. **It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Prince George Timber Supply Area (TSA) covers approximately 7 508 000 hectares in the north-central interior of British Columbia. It is bounded by Alberta on the east, Tweedsmuir Provincial Park on its south west arm and Spatsizi Plateau Wilderness Park on its northwest corner. About 71% of the Prince George TSA (approximately 5 327 000 hectares) is considered productive forest area managed by the Crown. Currently about 64% of the productive forest, or 45% of the total TSA, is considered available for timber harvesting under current forest management practices. These practices follow the standards and legislation set out by the *Forest Practices Code* and the agreements made under the Prince George, Vanderhoof and Fort St. James Land and Resource Management Plans (LRMPs). Within the area available for timber harvesting, most of the forests are dominated by lodgepole pine species, although there are also significant areas dominated by spruce, subalpine fir, cedar, hemlock and aspen species.

The results of this timber supply analysis suggest that harvest levels can be maintained at 9 073 661 cubic metres per year for 170 years before dropping to 8 800 000 for the long term. The target harvest level of 9 073 661 cubic metres per year incorporates the current AAC of 9 363 661 cubic metres per year less the uplift of 290 000 cubic metres per year for looper damaged cedar/hemlock stands, and less 100 000 cubic metres per year for the woodlots issued since the last determination plus 100 000 cubic metres per year for the current partition to salvage infested and damaged cedar/hemlock stands. The existing partition of 290 000 cubic metres per year for damaged cedar/hemlock stands is now considered to be more than is required to ensure adequate salvage. The harvest of 100 000 cubic metres per year proposed for these stands is just slightly above the long-term harvest level of 85 000 cubic metres per year obtainable from these stand types. The current remaining apportionment for woodlots in the TSA is 100 000 cubic metres per year. Approximately 67 000 hectares has been removed to account for these issued woodlots.

These results reflect current knowledge and information on forest inventory, growth, and management. However, uncertainty exists about several factors important in defining timber supply. A series of sensitivity analyses showed that these uncertainties could affect timber supply to varying degrees.

The robustness of the Prince George TSA timber supply must be examined in order to understand results of the sensitivity analyses. One of the alternative harvest flows indicates that an initial harvest of 12 450 000 cubic metres per year is achievable for the first 10 years falling at 10% per decade and achieving the long-term level of 8 800 000 cubic metres per year by decade four. Compared to the base case this forecast has little impact on the mid term and no impact on the long-term harvest flow. This alternative harvest flow allows an additional 45 million cubic metres, over and above the base case, to be harvested over the first 30 years of the harvest forecast. This 'excess' mature timber cushions the impact of several of the other sensitivity analyses.

Paradoxically, the short term (the next 20 years) is most sensitive to changes in volumes expected to be harvested from future regenerated stands. This is because of the large amount of available mature timber as demonstrated by the alternative harvest forecast discussed above. Two sensitivity analyses were done where these managed stand volumes were altered. When managed stands yields were artificially increased by 10% an even-flow harvest level of 9 550 000 cubic metres per year is achieved. This is 5.3 % above the base case initial harvest level. When future managed stand volumes are adjusted, based on old-growth site index (OGSI) studies, the even-flow harvest level is 10 256 000 cubic metres per year or 13.3 % above the initial base case level. When the short-term timber supply is affected positively by factors that should effect future or long-term harvest the term "allowable cut effect" is used.

One other sensitivity analysis shows an increase in the short-term harvest flow. Interest has been expressed in harvesting stands where aspen is the predominant species. Out of a total of 194 200 hectares of aspen leading stands, 61 700 hectares are estimated to be potential timber harvesting land base (economic aspen stands are those stands having a site index greater than 17 measured at a breast height age 50 years). This land base supports a 30-year harvest level of 145 000 cubic metres per year falling at 10% per decade to a long-term harvest level of 95 000 cubic metres per year 70 years from now. There are 12 300 hectares of leading-birch stands that also may be considered as potential timber harvesting land base. This would support an estimated annual harvest of between 15 000 and 25 000 cubic metres.

There were no sensitivity analyses which showed the short-term harvest level was lower than the base case.

The mid-term harvest level in this analysis is generally considered as the period of time between 21 and 170 years into the harvest flow projection. There are a number of sensitivities that affect the harvest flow in all or a part of this period. Most of these sensitivities reduce the harvest flow projections.

The largest potential effects on projected harvests over the mid term are associated with uncertainties in estimates of timber volumes in existing stands. Two audits conducted over the past 5 years suggest that the inventory estimate of volumes in the operable portion only of the spruce-leading stands in the Prince George Forest District part of the TSA (approximately the timber harvesting land) may be 21.2% higher than estimates based on ground measurements. This is a result of heights being overestimated on the inventory file by over 3 metres. If volumes in existing spruce-leading stands are indeed 21.2% lower than the inventory estimates and the current harvest level is maintained, this analysis shows that timber supply will be reduced by approximately 314 000 cubic metres per year (3.5%) from the base case level during decades eight to seventeen. After decade seventeen, when the harvest is mainly from managed stands, timber supply returns to the roughly the same level as projected in the base case. If existing yields were reduced for all stands in the TSA by 10% then the mid-term harvest level, years 21 to 170, would be reduced approximately 943 000 from the base case.

The sensitivity analysis that examined the impact of removing Supply Block A from the TSA showed reduction from the base case of approximately 584 000 cubic meters per year (6.4%) from years 40 to 170. The long-term harvest level would be reduced from 8 800 000 to 8 490 000 cubic metres per year. Supply Block A, an undeveloped area located in the remote northwest reaches of the Fort St. James Forest District, is currently accessed by air or British Columbia Rail, with sporadic timber harvesting. During the recent re-allocation exercise in the Prince George TSA, licensee operating-area replaceable forest licensee holders could not come to consensus on operations there. Supply Block A is 1 010 000 hectares in size, of which 175 000 hectares (17%) is potential timber harvesting land base, 5.2% of the TSA timber harvesting land base. Over 125 000 hectares are stands where Subalpine fir (Abies) is the dominant species. The vast majority of timber in the supply block is mature (greater than 140 years) and highly susceptible to pathogens like balsam bark beetle.

If the time required to achieve green-up was increased by 10 years across all landscape units, the initial harvest level of 9 073 661 cubic metres per year can be maintained for 7 decades at which time it falls to a long-term level 90 000 cubic metres per year below the base case long-term level of 8 800 000 cubic metres per year. Decreasing green-up ages (the time it takes to reach 3 and 5 metre green-up) by 10 years results in an increase to the harvest flow of approximately 364 000 cubic metres per year (4.0%) from years 70 to 170.

The long-term harvest level (after decade 17) is affected by several factors. If all of the forest was managed as part of the normal integrated resource management (IRM) zone the long-term harvest level could be increased 200 000 cubic metres per year to 9 000 000 cubic metres per year. If the timber supply area was managed as three separate timber supply units (split by forest districts) the long-term harvest level (decades 170 to 250) would be decreased by approximately 200 000 cubic metres per year to 8 600 000 cubic metres per year.

Executive Summary

Management for landscape-level biodiversity was modelled in this analysis through the use of forest cover requirements applied to each combination of natural disturbance type (NDT), biogeoclimatic subzone, and variant within each landscape unit. These targets were a weighted average of the low-, intermediate- and high-biodiversity emphasis option (BEO) targets with 45% assumed as lower, 45% as intermediate and 10% as higher.

In areas subject to the lower BEO, an initial drawdown of the old-seral requirements to one-third of the target was allowed. The base case incorporates old-growth targets for all natural disturbance types (NDT) and mature-plus-old objectives in NDT 3., as found in the Landscape Unit Planning Guide. A sensitivity analysis examined the implications of using the proposed interim BEO emphasis for each landscape unit rather than using the prorated 45:45:10 low-, intermediate- and high-targets and requiring old-seral targets to be met immediately. This sensitivity showed that the harvest level of 9 073 661 cubic metres per year could be maintained for 30 years after which a long-term harvest level of 8 770 000 cubic metres per year is achieved.

A further sensitivity analysis examined the effect on the harvest forecast of using the average 45:45:10 (low, intermediate and high) BEO while applying old, mature plus old, and early-seral targets to be met immediately on the timber harvesting land base. This resulted in the harvest level of 9 073 661 cubic metres per year being maintained for 20 years after which a long-term harvest level of 8 170 000 cubic metres per year is achieved.

The central interior of British Columbia is experiencing one of the worst mountain pine beetle outbreaks in recent history. To salvage timber damaged from this outbreak the AACs in the adjacent Quesnel and Lakes TSAs have been increased. A sensitivity analysis showed that harvest from pine-leading stands could comprise 7.5 million cubic metres per year of the base projection (9 073 661 cubic metres per year) for the next 20 years without causing disruptions to the base case harvest flow.

In conclusion, this analysis indicates that based on current inventory, growth and yield, and forest management information, timber harvests in the Prince George TSA can be maintained at 9 073 661 cubic metres per year for 170 years.

The analysis indicates that several factors related to the current forest inventory and management regime could affect timber supply. However, except for the likelihood that existing stand volumes may be overestimated, and site indices for old-growth stands may be underestimated, there is no conclusive evidence to suggest that significant inaccuracies exist in the information used in this analysis.

The socio-economic analysis for the Prince George TSA indicates that the current AAC of 9 363 661 cubic metres can support a provincial total of approximately 7,500 person-years of direct employment. Residents of the TSA account for approximately 86% of this direct employment. Direct forestry sector activity in the TSA supports a further 9,200 person-years of indirect and induced employment across the province.

The base case harvest forecast indicates that the Prince George TSA timber supply is robust and can remain at its current level for the foreseeable future. As such, any future changes in the industry and employment structure of the region will not likely be associated with a change in the timber supply.

The current AAC can provide the provincial government with average annual revenues of about $490 million, assuming full harvest of the available timber supply. Under the base case harvest forecast, the stable timber supply will ensure a continuation of those revenues, given current stumpage and tax rates.

Table of Contents

PREFACE III

EXECUTIVE SUMMARY IV

INTRODUCTION 1

1 DESCRIPTION OF THE PRINCE GEORGE TIMBER SUPPLY AREA 3

- 1.1 THE ENVIRONMENT 6
- 1.2 FIRST NATIONS 9

2 INFORMATION PREPARATION FOR THE TIMBER SUPPLY ANALYSIS 10

- 2.1 LAND BASE INVENTORY 10
- 2.2 TIMBER GROWTH AND YIELD 19
- 2.3 MANAGEMENT PRACTICES 19
- 2.4 CHANGES SINCE THE 1995 PRINCE GEORGE TSA ANALYSIS 23

3 TIMBER SUPPLY ANALYSIS METHODS 24

4 RESULTS 25

- 4.1 BASE CASE HARVEST FORECAST 25
- 4.2 AVERAGE AGE, AREA, AND VOLUME HARVESTED 29
- 4.3 AGE CLASS PROFILE OVER TIME 31

5 TIMBER SUPPLY SENSITIVITY ANALYSES 33

- 5.1 ALTERNATIVE HARVEST FLOWS 33
- 5.2 THE CONTRIBUTION FROM STANDS THAT HAVE CEDAR AND HEMLOCK AS THE MAJOR SPECIES. 36
- 5.3 THE CONTRIBUTION OF THE THREE FOREST DISTRICTS TO THE TSA HARVEST FLOW 37
- 5.4 THE CONTRIBUTION OF SUPPLY BLOCK A TO THE TSA HARVEST FLOW 38
- 5.5 UNCERTAINTY IN THE CONTRIBUTION OF STANDS WHERE DECIDUOUS SPECIES DOMINATE. 40
- 5.6 MOUNTAIN PINE BEETLE EPIDEMIC 42
- 5.7 UNCERTAINTY IN THE ESTIMATED EXISTING STAND YIELDS 43
- 5.8 UNCERTAINTY IN THE ESTIMATED MANAGED STAND YIELDS 45
- 5.9 UNCERTAINTY ABOUT MANAGEMENT REQUIREMENTS IN ALL MANAGEMENT ZONES 46
- 5.10 UNCERTAINTY IN MINIMUM HARVESTABLE AGES 46
- 5.11 UNCERTAINTY IN GREEN-UP HEIGHT 48
- 5.12 UNCERTAINTY IN SITE PRODUCTIVITY 49
- 5.13 UNCERTAINTY IN APPLICATION OF BIODIVERSITY SERAL STAGE RETENTION RECOMMENDATIONS 51
- 5.14 UNCERTAINTY IN AGING OF THE FOREST IN THE NON-TIMBER HARVESTING LAND BASE 55

6 SUMMARY AND CONCLUSIONS OF THE TIMBER SUPPLY ANALYSIS 55

Table of Contents

7 SOCIO-ECONOMIC ANALYSIS **58**
- 7.1 CURRENT SOCIO-ECONOMIC SETTING 58
  - 7.1.1 Current population and demographic trends 58
  - 7.1.2 Economic profile 59
- 7.2 PRINCE GEORGE TSA FOREST INDUSTRY 64
  - 7.2.1 Current allowable annual cut 64
  - 7.2.2 Prince George TSA harvest history 65
  - 7.2.3 Prince George TSA major licensees and processing facilities 66
  - 7.2.4 Forest sector employment and employment coefficients 78
  - 7.2.5 Prince George TSA employment income 80
  - 7.2.6 Provincial government revenues 80
- 7.3 SOCIO-ECONOMIC IMPLICATIONS OF THE BASE CASE HARVEST FORECAST 81
  - 7.3.1 Short- and long-term implications of alternative harvest levels 81
  - 7.3.2 Community-level impacts 84
  - 7.3.3 Nature, production capabilities and timber requirements of processing facilities 84
  - 7.3.4 Regional timber supply issues 84
- 7.4 SUMMARY 85

8 REFERENCES **86**

9 GLOSSARY **87**

APPENDIX A DESCRIPTION OF DATA INPUTS AND ASSUMPTIONS FOR THE TIMBER SUPPLY ANALYSIS **91**

INTRODUCTION **92**

A.1 INVENTORY INFORMATION **93**

A.2 ZONE AND ANALYSIS UNIT DEFINITIONS **96**

A.3 DEFINITION OF THE TIMBER HARVESTING LAND BASE **98**

A.4 FOREST MANAGEMENT ASSUMPTIONS **113**

A.5 VOLUME ESTIMATES FOR EXISTING STANDS **121**

A.6 VOLUME ESTIMATES FOR MANAGED STANDS **124**

APPENDIX B SOCIO-ECONOMIC ANALYSIS BACKGROUND INFORMATION **127**

B.1 LIMITATIONS OF ECONOMIC ANALYSIS **128**

B.2 ECONOMIC IMPACT ANALYSIS METHODOLOGY **129**

Table of Contents

Tables

TABLE 1. SPECIES AT RISK AS IDENTIFIED UNDER THE FOREST PRACTICES CODE IN THE PRINCE GEORGE FOREST DISTRICT 7

TABLE 2. SPECIES AT RISK AS IDENTIFIED UNDER THE FOREST PRACTICES CODE IN THE VANDERHOOF FOREST DISTRICT 7

TABLE 3. SPECIES AT RISK AS IDENTIFIED UNDER THE FOREST PRACTICES CODE IN THE FORT ST. JAMES FOREST DISTRICT 8

TABLE 4. DETERMINATION OF THE TIMBER HARVESTING LAND BASE FOR THE PRINCE GEORGE TSA 13

TABLE 5. SUMMARY OF BIOGEOCLIMATIC ZONE AREAS — PRINCE GEORGE TSA, 2001 15

TABLE 6. LODGEPOLE PINE HARVEST BY FOREST DISTRICT FOR THE FIRST 20 YEARS OF THE MOUNTAIN PINE BEETLE HARVEST FORECAST — PRINCE GEORGE TSA, 2001 42

TABLE 7. OLD GROWTH SITE INDEX (OGSI) ADJUSTMENTS TO SITE INDEX 50

TABLE 8. LANDSCAPE UNIT FPC PROPOSED EMPHASIS 52

TABLE 9. SUMMARY OF SENSITIVITY ANALYSIS — PRINCE GEORGE TSA, 2001 55

TABLE 10. PRINCE GEORGE TSA AND SELECTED COMMUNITY POPULATION STATISTICS, 1991–2000 59

TABLE 11. SECTORAL COMPARISON OF EMPLOYMENT MULTIPLIERS — PRINCE GEORGE TSA, 1996 64

TABLE 12. PRINCE GEORGE TSA ALLOWABLE ANNUAL CUT, BY LICENCE TYPE, 1997 64

TABLE 13. PRINCE GEORGE TSA VOLUMES BILLED, BY LICENCE TYPE, 1993–2000 65

TABLE 14. APOLLO VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 66

TABLE 15. CANFOR VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 67

TABLE 16. CARRIER LUMBER VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 68

TABLE 17. L. & M. LUMBER VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 69

TABLE 18. LAKELAND VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 70

TABLE 19. PLATEAU VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 71

TABLE 20. STELLA-JONES VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 72

TABLE 21. STUART LAKE LUMBER VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 73

TABLE 22. THE PAS LUMBER VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 74

TABLE 23. WELDWOOD VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 75

TABLE 24. WEST FRASER VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 76

TABLE 25. PRINCE GEORGE TSA EMPLOYMENT AND EMPLOYMENT COEFFICIENTS,[10] AVERAGE 1996–1998 79

TABLE 26. AVERAGE DIRECT AND INDIRECT/INDUCED INCOMES AND TOTAL EMPLOYMENT INCOME, 1996-1998 80

TABLE 27. AVERAGE PROVINCIAL GOVERNMENT REVENUES, 1996-1998 80

TABLE 28. PRINCE GEORGE TSA SOCIO-ECONOMIC IMPACTS: BASE CASE HARVEST FORECAST[A] 83

Table of Contents

Tables (continued)

Table A-1. Inventory information 94

Table A-2. Objectives to be tracked 96

Table A-3. Definition of analysis units and timber harvesting land base for the base case by forest district 97

Table A-4. Ownership categories that do not contribute to the timber harvesting land base or other forest management objectives in the Prince George TSA 98

Table A-5. Ownership categories that are excluded from the timber harvesting land base but contribute to some forest management objectives 99

Table A-6. Ownership categories that are included in the timber harvesting land base 99

Table A-7. Description of environmentally sensitive areas 100

Table A-8. Criteria for defining economic operability for mature stands (applies to stands greater than 140 years old 101

Table A-9. Criteria for defining merchantable mature stands — per cent inclusion into the timber harvesting land base 102

Table A-10. Criteria for defining merchantable mature cedar and hemlock stands 103

Table A-11. Criteria for defining merchantable juvenile (immature) stands 103

Table A-12. Estimates for existing roads, trails, and landings 105

Table A-13. Estimates for future roads, trails, and landings 105

Table A-14. Riparian reserve and riparian management zone criteria 106

Table A-15. Riparian reserve and riparian management zone reductions 107

Table A-16. Forest district standards for retention in cutblocks — total forest area 107

Table A-17. Reductions to reflect wildlife tree retention in cutblocks — timber harvesting land base 107

Table A-18. Cultural heritage resource considerations 109

Table A-19. Prince George, Vanderhoof and Robson Valley Crown land plans (zone, modelling assumption) 110

Table A-20. Exclusion of isolated areas 111

Table A-21. Determination of the timber harvesting land base for the three forest districts within the Prince George TSA 112

Table A-22. Utilization levels 113

Table A-23. Minimum harvestable age criteria 114

Table A-24. Percentage of total harvested area by silvicultural system 114

Table A-25. Unsalvaged losses 115

Table A-26. Regeneration assumptions by analysis unit for the Fort St. James Forest District 116

Table A-27. Regeneration assumptions by analysis unit for the Prince George and the Vanderhoof Forest Districts 117

Table A-28. Treatment of not satisfactorily restocked (NSR) areas 118

Table A-29. Forest cover requirements — other than biodiversity requirements 119

Table A-30. Old and mature plus old seral requirements for landscape unit and natural disturbance type (NDT) used in the base case. 120

Table A-31. Timber volume tables for existing natural stands (cubic metres per hectare) 121

Table A-32. Timber volume tables for managed stands (cubic metres per hectare) 124

Table B-1. Total employment multipliers 131

Table B-2. Estimates of provincial government revenue — Prince George TSA 132

Table of Contents

Figures

Figure 1. Map of the Prince George Timber Supply Area, Prince George Forest Region. 5

Figure 2. Composition of the total and Crown forested land bases — Prince George TSA, 2001 14

Figure 3. Area by biogeoclimatic classification — Prince George TSA, 2001 16

Figure 4. Area by analysis units — Prince George TSA timber harvesting land base, 2001 17

Figure 5. Current age class composition — Prince George TSA forested land base, 2001 18

Figure 6. Timber harvesting land base by management emphasis — Prince George TSA timber harvesting land base, 2001 22

Figure 7. Base case harvest forecast — Prince George TSA, 2001 26

Figure 8. Total, merchantable and available growing stocks — Prince George TSA, 2001. 27

Figure 9. Harvest contribution from existing and managed stands — Prince George TSA, 2001 28

Figure 10. Average age of stands harvested over time — Prince George TSA base case, 2001 29

Figure 11. Average area and average volume per hectare harvested over time — Prince George TSA base case, 2001 30

Figure 12. Changes in age composition on the productive land base over time — Prince George TSA base case, 2001 32

Figure 13. Alternative harvest forecasts — Prince George TSA, 2001. 34

Figure 14. Growing stock comparison of the base case to alternative one— Prince George TSA, 2001 35

Figure 15. Contribution from cedar- and hemlock-leading stands to the base case — Prince George TSA, 2001. 36

Figure 16. Contribution of the three district harvest levels to the base case — Prince George TSA, 2001. 37

Figure 17. Steady state harvest flow by forest district — Prince George TSA, 2001. 38

Figure 18. Species distribution of the forested land base of supply block A — Prince George TSA, 2001. 39

Figure 19. Base case showing the contribution from supply block A and the effect on the harvest forecast of removing supply block A — Prince George TSA, 2001 39

Figure 20. Productive area of aspen stands by site index — Prince George TSA, 2001. 41

Figure 21. Harvest forecast from aspen stands — Prince George TSA, 2001. 41

Figure 22. Harvest forecast incorporating the inventory audit results — Prince George TSA, 2001 44

Figure 23. The effect on the harvest forecast of decreasing or increasing volume estimates for existing unmanaged stands — Prince George TSA, 2001. 44

Figure 24. The effect on the harvest forecast of decreasing or increasing volume estimates for managed stands by 10% — Prince George TSA, 2001 45

Figure 25. Harvest forecasts if minimum harvestable ages are older than those used in the base case — Prince George TSA, 2001. 47

Figure 26. The effect on the harvest forecast of decreasing or increasing the length of time to achieve 3 and 5-metre green-up — Prince George TSA, 2001. 48

Figure 27. The effect on the harvest forecast of using the proposed BEO emphasis for each landscape unit and requiring old-seral targets to be met immediately — Prince George TSA, 2001. 53

Figure 28. The effect on the harvest forecast of using the average 45:45:10 (low, intermediate and high) BEO while applying old, mature plus old, and early-seral targets to be met immediately on the timber harvesting land base — Prince George TSA, 2001 54

Figure 29. Prince George Forest District experienced labour force by sector, 1996. 61

Figure 30. Vanderhoof Forest District experienced labour force by sector, 1996. 61

Figure 31. Fort St. James Forest District experienced labour force by sector, 1996. 62

Introduction

Timber supply* is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial profitability of harvest operations depends upon the terrain, as well as the physical characteristics of the trees to be harvested. Determining the physical characteristics of trees in the future requires knowledge of their growth. Decisions about whether a stand is available for harvest often depend on how its harvest could affect other forest values, such as wildlife or a recreation area.

These factors are also subject to both uncertainty and different points of view. Financial profitability may change as world timber markets change. Unforeseen losses due to fire or pest infestations will alter the amount and value of timber. The appropriate balance of timber and non-timber values in a forest is an ongoing subject of debate, and is complicated by changes in social objectives over time.

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based, and which define current forest management — as well as the uncertainties affecting these conditions — must first be understood. Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit (a geographic area). For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by the chief forester of British Columbia in determining an allowable annual cut (AAC)* — the permissible harvest level for the area.

Timber supply projections made for TSAs look far into the future — 250 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occurs regularly, using new information and knowledge to update the timber supply picture. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

**Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page, as well as in the glossary.*

Timber supply
The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)
An integrated resource management unit established in accordance with Section 7 *of the* Forest Act.

Allowable annual cut (AAC)
The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Introduction

Timber supply analysis involves three main steps. The first is collecting and preparing information and data. The British Columbia Forest Service forest inventory* plays a major role in this. The second step is using this data along with a timber supply computer model or models* to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions for the factors discussed above. The third step is interpreting and reporting results.

The following sections outline the timber supply analysis for the Prince George TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Timber supply analysis methodology and results are presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. This is followed by a summary and conclusions for the timber supply analysis in Section 6. Section 7 shows results of a socio-economic analysis for the Prince George TSA. Appendixes A and B contain further details about the data and assumptions used in the analysis.

As part of the timber supply review (TSR), information is gathered on the short- and long-term implications of alternative harvest levels, and the capabilities and requirements of existing and proposed processing facilities. The socio-economic analysis provides information for the chief forester and the local community to better understand the potential magnitude of impacts associated with any proposed harvest level changes.

The socio-economic analysis considers the current and projected levels of forestry activity associated with the Prince George TSA within the context of regional timber supplies and production capacity. It does this by examining the profile of the region and the local forest industry; and by assessing employment and income implications of the timber harvesting levels projected in the base case.

The analysis includes estimates of the employment and income impacts associated with timber supply analysis projections by three main sectors: harvesting and other woodlands-related, processing, and silviculture. Employment is measured in person-years. Employment income is calculated using average industry income estimates.

Data on direct employment, harvest levels, and fibre flows was obtained by surveying licensees and mill operators. The information was used to estimate harvesting, processing and silviculture direct employment averages associated with the harvest and the proportion of workers living in the area. The estimates of local and provincial harvesting, processing, and silviculture direct employment were then used to determine ratios of employment per 1000 cubic metres of timber harvested.

Indirect and induced employment figures were calculated using the Prince George TSA and provincial employment multipliers developed by the Ministry of Finance. Indirect impacts result from direct businesses purchasing goods and services; induced impacts result from direct employees purchasing goods and services. Employment coefficients per 1000 cubic metres were also determined for the indirect and induced impacts.

To estimate the level of employment that could be supported by alternative harvest rates, projected timber supply levels were multiplied by the calculated employment coefficients. It should be noted that employment coefficients are based on current productivity, harvest practices and management assumptions and will not likely reflect industry conditions decades into the future. As such, the employment estimates can only be viewed as general indicators.

Forest inventory
An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

Model
An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.

1 Description of the Prince George Timber Supply Area

The Prince George Timber Supply Area (TSA) is situated in the north-central interior of British Columbia and covers approximately 7.5 million hectares, making it one of the largest management units in the province. The TSA stretches from near the Alberta border at its southeast corner to Tweedsmuir Provincial Park along its southwest arm, and northwest to the Spatsizi Plateau Wilderness Park. This TSA is one of six in the Prince George Forest Region and includes three of the eight forest districts in the region. The Prince George TSA is administered by the Prince George, Vanderhoof and Fort St. James Forest District offices.

The Prince George TSA is topographically diverse. The central and southwestern portion is fairly flat and rolling with gentle slopes, and supports forests of predominantly lodgepole pine and white spruce. The eastern part of the TSA runs along the Rocky Mountains, where spruce and subalpine fir dominate higher elevations and forests of large old western redcedar and western hemlock dominate lower elevations. In the northwestern portion of the TSA, the terrain is mountainous due to the Omineca and Skeena mountain ranges. In this part of the TSA, pine dominates the valley bottoms, spruce the lower and mid slopes, and subalpine fir the upper slopes. The TSA includes the Fraser, Nechako, Stuart, Skeena, Sustut, Nation and McGregor river systems, as well as numerous lakes of all sizes.

Within the land base currently considered available for timber harvesting, lodgepole pine stands dominate about 51% of the area, spruce 29%, subalpine fir 19%, and Douglas-fir 1%. There is a relatively high proportion of younger pine stands that have developed following major fire disturbances 40 or more years ago. The youngest stands in the TSA result from replanting following logging and are predominantly composed of spruce, lodgepole pine and Douglas-fir. There are also some relatively old stands, mainly comprised of spruce and subalpine fir, found in areas with higher precipitation. In addition, there are some very old cedar stands found in the Interior Cedar Hemlock biogeoclimatic zone.

About 71% of the Prince George TSA land base is considered Crown forest land managed by the British Columbia Forest Service (approximately 5.33 million hectares). Currently about 64% of the Crown forest land is considered available for harvesting (45% of the total TSA land base).

The current allowable annual cut (AAC) in the Prince George TSA is 9.364 million cubic metres. This level was set by the chief forester on January 23, 1996, and represented an increase of about 3% from the previous level. The AAC includes a partition* of 290 000 cubic metres per year for harvesting in cedar and hemlock stands, with a high priority on salvaging stands heavily damaged by hemlock looper.

Significant changes that influence forest management have occurred since the last timber supply review was completed. These changes include:

- implementation of the *Forest Practices Code* (FPC)*;
- approval of three Land and Resource Management Plans;
- modification of the operability* map;
- delineation of interim landscape units* and assignment of biodiversity* emphasis options;

Partition
A portion of the AAC that is attributable to certain types of timber and/or terrain.
Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Operability
Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.

Landscape unit
A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Biodiversity (biological diversity)
The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.

- scenic areas have been made known for the Fort St. James Forest District;
- mapping and classification of lakeshore and wetlands has been completed;
- increased incidence of mountain pine beetle in the southern and central part of the TSA;
- Caribou management plans have been approved in the Fort St. James and Prince George Forest Districts, and the draft caribou management plan for the Vanderhoof Forest District will be made known prior to the AAC determination;
- establishment of an *Innovative Forestry Practices Agreement* in the Vanderhoof Forest District; and
- improved understanding of the ecology of the Interior Cedar Hemlock area and the effect of hemlock looper.

According to the 1996 census, the population of the Prince George TSA is about 105,762, an increase of about 9% since 1991. More than 70% of the residents live in the City of Prince George. The other two main communities are Vanderhoof and Fort St. James, and smaller communities include Fraser Lake, Fort Fraser, Stoney Creek, Hixon, Strathnaver, Giscome, Upper Fraser, Willow River, Summit Lake, Bear Lake, McLeod Lake, Tachie, Yekooche, Dzitl'ainli and Takla Landing.

The Vanderhoof, Fort St. James and Prince George Land and Resource Management Plan (LRMP) processes began in 1992 and 1993. The planning processes provided an opportunity for the public, interest groups and government to make recommendations regarding new protected areas* and future management of public lands in the area.

The Vanderhoof LRMP, a consensus recommendation to government on all aspects of land and resource management in an area covering 1.4 million hectares, received government approval in February 1997. Six proposed protected areas have been declared either under the *Parks Act* or the *Environmental Land Use Act*. The Fort St. James LRMP, covering an area of 3.2 million hectares, was agreed to by consensus and subsequently approved by government in March, 1999. It included 187 000 hectares of proposed protected areas; all but one of these have now been declared under either the *Parks Act* or the *Environmental Land Use Act*. The Prince George LRMP, covering 3.4 million hectares, was also a consensus recommendation and was approved by government in January 1999. Of the 24 new proposed protected areas, or additions to existing parks, 23 have been designated as Class A parks and one has not been established. Portions of three areas are established as protected areas under the *Environmental Land Use Act*.

Numerous natural resources are associated with the forest land base in the Prince George TSA, including forest products, minerals, recreation and tourism amenities, and a wide variety of wildlife habitats. The diverse terrain, lakes and rivers offer a wide range of opportunities for recreation, including fishing, hunting, hiking, camping, boating, canoeing, horse trekking, mountain biking, caving, snowmobiling and skiing.

Protected area
A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).

1 Description of the Prince George Timber Supply Area

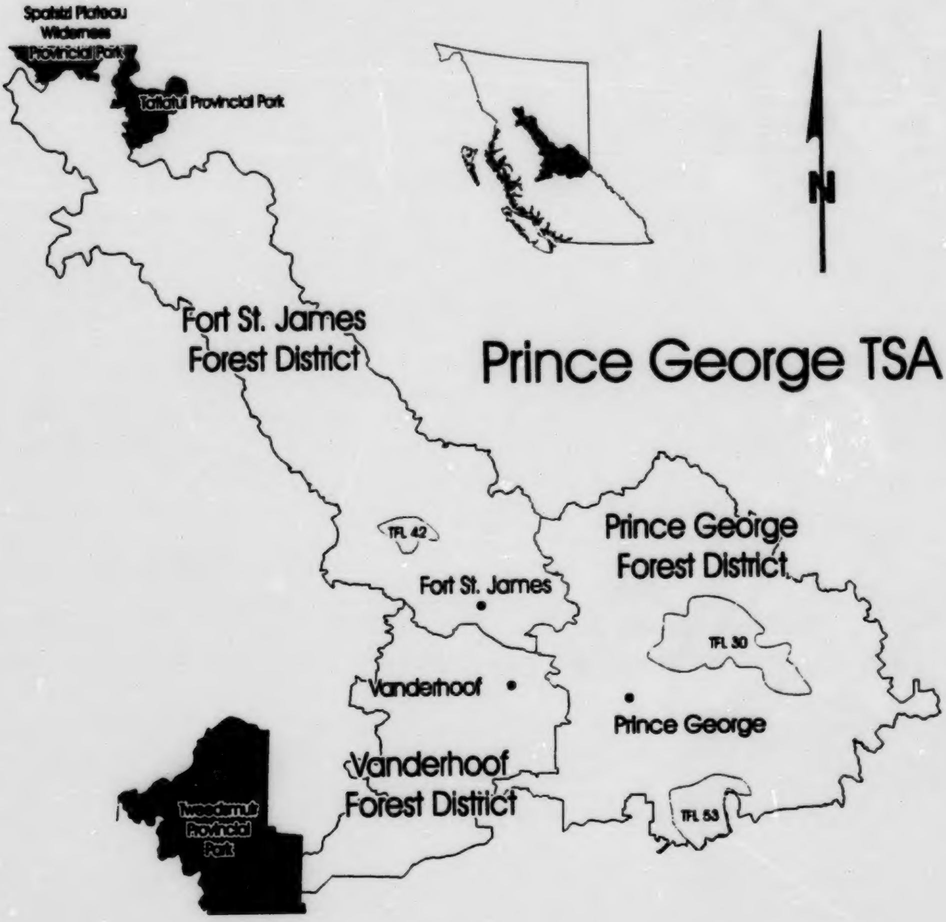

Spatsizi Plateau Wilderness Provincial Park
Tatlatui Provincial Park
N
Fort St. James Forest District
Prince George TSA
TFL 42
Fort St. James
Prince George Forest District
TFL 30
Vanderhoof
Prince George
Vanderhoof Forest District
Tweedsmuir Provincial Park
TFL 53

Figure 1. Map of the Prince George Timber Supply Area, Prince George Forest Region.

1 Description of the Prince George Timber Supply Area

1.1 The environment

The five biogeoclimatic zones* that occur in the Prince George TSA reflect the diversity of climates and vegetation in the area. The varied ecological features contribute to the high biodiversity values found in this TSA.

The Sub-Boreal Spruce (SBS) zone is the dominant zone, extending over most of the TSA. The climate of this zone is characterized by severe, snowy winters and relatively warm, moist and short summers. White spruce and subalpine fir are the dominant climax tree species. Lodgepole pine, a seral species in the SBS zone, is also common in mature forests in the drier parts of the zone. Douglas-fir is usually a long-lived seral species in the SBS zone, occurring abundantly on dry, warm, rich sites and as a consistent, although small, component in the southern part of the TSA. Lodgepole pine, aspen and birch are often found as early seral species.

The Sub-Boreal Pine-Spruce (SBPS) zone has very limited occurrence in the southern part of the TSA, at elevations below the SBS zone. The climate is characterized by cold, dry winters and cool, dry summers. Tree growth is restricted by the cool, dry conditions during the short growing season. Nighttime frosts are common in all seasons. Lodgepole pine is by far the most common tree species, but Douglas-fir, white spruce and trembling aspen are also common. Other occasional species are subalpine fir, birch and cottonwood.

The Interior Cedar-Hemlock (ICH) zone has a small occurrence in the eastern part of the TSA at lower to middle elevations. The ICH is characterized by cool, wet winters and warm, dry summers and is the most productive forest zone in the interior of British Columbia with the highest diversity of tree species of any zone in the province. The dominant tree species are western redcedar, western hemlock, spruce, lodgepole pine and subalpine fir. This zone has recently received much attention because of some rare and unique attributes. It is also distinguished by being an interior (non-coastal) rainforest zone, one of a very few places this occurs in the world. Because of the productivity and rainfall, western redcedar trees, in particular, have achieved great size and age.

The Engelmann Spruce-Subalpine Fir (ESSF) zone is found at higher elevations in the TSA. It generally occurs above the ICH or SBS zone, and below the Alpine Tundra. The ESSF has a relatively cold, moist and snowy continental climate. Growing seasons are cool and short, while winters are long and cold. Engelmann spruce and subalpine fir are the dominant climax tree species, while lodgepole pine is common after fires.

The Alpine Tundra (AT) zone occurs in small areas at high elevations above the ESSF zone. The climate is cold, windy and snowy with a short, cool growing season. By definition this zone is treeless and vegetation is dominated by shrubs, herbs, mosses and lichens. Much of the alpine landscape lacks vegetation and is the domain of rock, ice and snow.

The Prince George TSA hosts a wide variety of wildlife species, including mountain and woodland caribou, moose, elk, mule and white-tail deer, mountain goat, black bear, grizzly bear, cougar, wolf, beaver, otter, mink, muskrat, fisher, wolverine and marten, as well as many bird species including waterfowl. The rivers, streams and lakes of the area support a rich variety of habitats for many game fish species including kokanee, burbot (ling), white sturgeon, steelhead, lake trout, Arctic grayling, bull and rainbow trout, lake and mountain whitefish, and Chinook, coho, pink and sockeye salmon.

Under the *Forest Practices Code*, a process exists for identifying species at risk and designating wildlife habitat areas with specific management practices. The wildlife species that have been declared Identified Wildlife in the main ecosections of the Prince George, Vanderhoof and Fort St. James Forest Districts are presented in Tables 1, 2 and 3 respectively.

Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.

Table 1. Species at risk as identified under the Forest Practices Code in the Prince George Forest District

Common names of identified wildlife	Ecosection							
	Nazko Lowland	**Quesnel Lowland**	**Hart Ranges**	**McGregor Plateau**	**Nechako Upland**	**Bowron Valley**	**Cariboo Mtns.**	**Upper Fraser Trench**
Bull trout	x	x	x	x	x	x	x	x
American bittern	x	x			x	x	x	
Trumpeter swan				x	x	x	x	x
Northern goshawk *atricapillus*	x	x	x	x	x	x	x	x
Sandhill crane	x	x	x	x	x	x		x
Fisher	x	x		x	x	x		x
Grizzly bear	x	x	x	x	x	x	x	x
Mountain goat			x				x	
Bighorn sheep *canadensis*			x					

Source: *Managing Identified Wildlife Procedures and Measures, Volume 1.* February 1999.

Table 2. Species at risk as identified under the Forest Practices Code in the Vanderhoof Forest District

Common names of identified wildlife	Ecosection			
	Bulkley Basin	**Nazko Upland**	**Babine Upland**	**Nechako Lowland**
Bull trout	x	x	x	x
American white pelican		x		x
American bittern		x	x	x
Trumpeter swan	x	x	x	x
Northern goshawk *atricapillus*	x	x	x	x
Sandhill crane	x	x	x	x
Fisher	x	x	x	x
Grizzly bear	x	x	x	x

Source: *Managing Identified Wildlife Procedures and Measures, Volume 1.* February 1999.

Table 3. Species at risk as identified under the Forest Practices Code in the Fort St. James Forest District

Common names of identified wildlife	Ecosection					
	Babine Upland	Nechako Upland	Eastern Skeena Mtns.	Manson Plateau	Southern Omineca Mtns.	Cassiar Ranges
Bull trout	x	x	x	x	x	x
American bittern	x	x		x		
Trumpeter swan	x	x	x	x	x	x
Northern goshawk *atricapillus*	x	x	x	x	x	x
Sandhill crane	x	x	x	x		
Fisher	x	x	x	x	x	x
Grizzly bear	x	x	x	x	x	x
Mountain goat			x	x	x	x

Source: *Managing Identified Wildlife Procedures and Measures, Volume 1.* February 1999.

Although the above listed species have been identified as species at risk, no wildlife habitat areas have yet been designated.

Current forest management practices follow the legislation and guidelines set out by the *Forest Practices Code*. Consequently, the protection of wildlife and the environment are managed through the *Code*. In addition, the provincial government has adopted as policy the three LRMPs that provide direction regarding water, fisheries, biodiversity, caribou habitat, grizzly bear habitat, moose habitat, deer habitat, marten habitat, recreation and tourism, community watersheds, and other forest cover constraints.

1.2 First Nations

The Prince George TSA is home to a significant First Nations population which constitutes about 6% of the total TSA population. Fourteen First Nations bands have reserves within the TSA, with a combined population of about 6,140. These include Nak'azdli, Takla Lake, Tl'azt'en, Cheslatta, Nadleh Whut'en, Stellat'en, Saik'uz, Lhoosk'uz Dene, Ulkatcho, Lheidli T'enneh, McLeod Lake, Dzitl'ainli, Yekooche and Nazko First Nations. In addition, the Gitxsan, Natoot'en, Kaska Dena, Tsay Keh Dene, Dzitl'ainli, Red Bluff and Tahltan First Nations have asserted traditional territories within the TSA.

The following first Nations are participating in the British Columbia Treaty Process and are at Stage 3 to Stage 6 of the land claim process: Cheslatta, Lheidli T'enneh, Nazko, Yekooche, Nak'azdli, Takla Lake, Tl'azt'en, Nadleh Whut'en, Stellat'en, Saik'uz, Gitxsan, Kaska Dena and Tsay Keh Dene.

The McLeod Lake First Nation and the federal and provincial governments have reached an agreement on the *McLeod Lake Indian Band Treaty No. 8 Adhesion and Settlement Agreement*. This information will be considered in this timber supply review. When other treaty negotiations or agreements are concluded, they will be considered in future timber supply reviews.

Forestry is an important source of employment for many of the First Nations in this TSA, through native and non-native enterprises (harvesting, wood processing, silviculture activities). First Nations hold several forest licenses, and some cooperative partnerships with the local forest industry have been developed. All of the First Nations have expressed concern about timber harvesting in areas with high value for cultural and traditional uses, such as trapping, hunting and fishing.

Cultural heritage inventory studies, archaeological impact assessments and traditional-use surveys that have been completed will be considered in the Timber Supply Review.

2 Information Preparation for the Timber Supply Analysis

Timber supply analysis requires three general categories of information: land base inventory; timber growth and yield; and management practices. These three categories are discussed below. Also, in preparation for the analysis, a number of changes since the 1995 Prince George TSA timber supply analysis were noted, and are described in Section 2.4, "Changes since the 1995 Prince George TSA analysis."

2.1 Land base inventory

Land base information used in this analysis came in the form of a computer file compiled in 1998 by the British Columbia Forest Service. This file contains information on the forest land in the Prince George TSA including general geographic location, area, nature of forest cover (such as presence or absence of trees, species, number of trees, age, and timber volume), and other characteristics such as environmental sensitivity and physical accessibility (operability). Stand attributes such as tree height, stocking* and age have been projected to 1998. The inventory file has been updated to account for timber harvesting up to 1995 for the Prince George TSA.

The inventory file represents the land base for the entire TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur. Examples are land set aside for parks, areas needed to protect wildlife habitat, areas in utility and transportation corridors, and residential and industrial development. A description of these areas specific to the Prince George TSA is provided below. These types of areas do not contribute to the timber harvesting land base* of the Prince George TSA. Before assessing timber supply, these non-contributing areas are identified and separated from the timber harvesting land base.

Identifying areas as not contributing to timber supply does not mean the area is removed from the Prince George TSA. The British Columbia Forest Service still manages the entire area of the TSA (except for designated areas under the jurisdiction of other agencies) as a land unit that contributes a mix of timber and non-timber values. The timber supply is managed within this integrated resource context, and the analysis described herein is consistent with this philosophy.

This section describes the types of areas that do not contribute to the timber harvesting land base. Use of the term timber harvesting land base in this report does not mean the area is open to unrestricted logging. Rather, it implies that forests in the area contain timber of sufficient economic value — and sites of adequate environmental resilience, to accommodate timber harvesting with due care for other resources.

For the Prince George TSA, the following types of areas were excluded from the timber harvesting land base.

- areas not managed by the British Columbia Forest Service —non-Crown areas, such as private land, Indian Reserves, and parks which are removed from the TSA. The forested portions of parks and ecological reserves are included in this analysis since they contribute towards biodiversity values. Previously accounted woodlot licence* areas are also removed as their AAC is determined separately.
- non-forest areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies).
- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- environmentally sensitive areas* (ESA) — areas with sensitive soils, high value recreation areas, high value wildlife areas, or where there may be difficulty regenerating a new crop of trees.

Stocking
The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
Timber harvesting land base
Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.

Woodlot licence
An agreement entered into under the Forest Act. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.
Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.

- physically inoperable areas — staff in the Prince George Forest Region have developed a physical operability system to classify all Crown forested area within the TSA by the harvesting system that is likely to be used there. This system is described in more detail in the data package published as the appendix to this report. In the system, inoperable areas are characterized by slopes currently exhibiting, or with a high likelihood of having, active failure.
- economically inoperable areas — economic operability uses harvesting system (cable, conventional, mixed) combined with minimum economic criteria such as volume per hectare for mature stands and site index* for immature stands to net out those stands that are currently uneconomic to harvest.
- unmerchantable mature stands — stands that are physically operable and exceed economic operability criteria yet are not currently utilized or have marginal merchantability because of height, piece size or stocking density. Included in this are deciduous*-leading stands.
- unmerchantable immature stands — forest growing in these areas are projected to have a volume of less than the economic operability criteria when they become mature. Productivity is measured as stand site index.
- Sustut local resource use plan (LRUP) preservation zone — the LRUP approved a visually sensitive preservation zone around the Sustut River in the northern part of the TSA. The land and resource management plan (LRMP) table endorsed this.
- caribou high habitat — Ministry of Forests (MoF) and Ministry of Water, Land and Air Protection (MWLAP) have jointly approved a strategy to protect critical caribou habitat.
- existing unclassified roads, trails and landings (RTLs) — areas of forest land that have been removed from timber production due to access development and harvesting to date.
- riparian area* — area otherwise available for timber production, a portion of which is assumed to be unavailable for harvesting to provide protection for riparian and stream ecosystems.
- wildlife tree* retention — allowance for block tree retention for wildlife
- cultural heritage — areas of cultural significance.
- Crown land plan — areas where the approved Crown land plan designates crown land for uses not compatible with forestry operations.
- isolated high cost areas — these are areas where potential timber harvesting land base exists but is too scattered and isolated to support road development.
- newly created parks — these areas were removed from the timber harvesting land base.
- McLeod Lake Band Treaty settlement areas — these are lands selected by the McLeod Lake Band adhering to Treaty-8.

Site index
A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.
Deciduous
Deciduous trees shed their leaves annually and commonly have broad-leaves.

Riparian area
Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

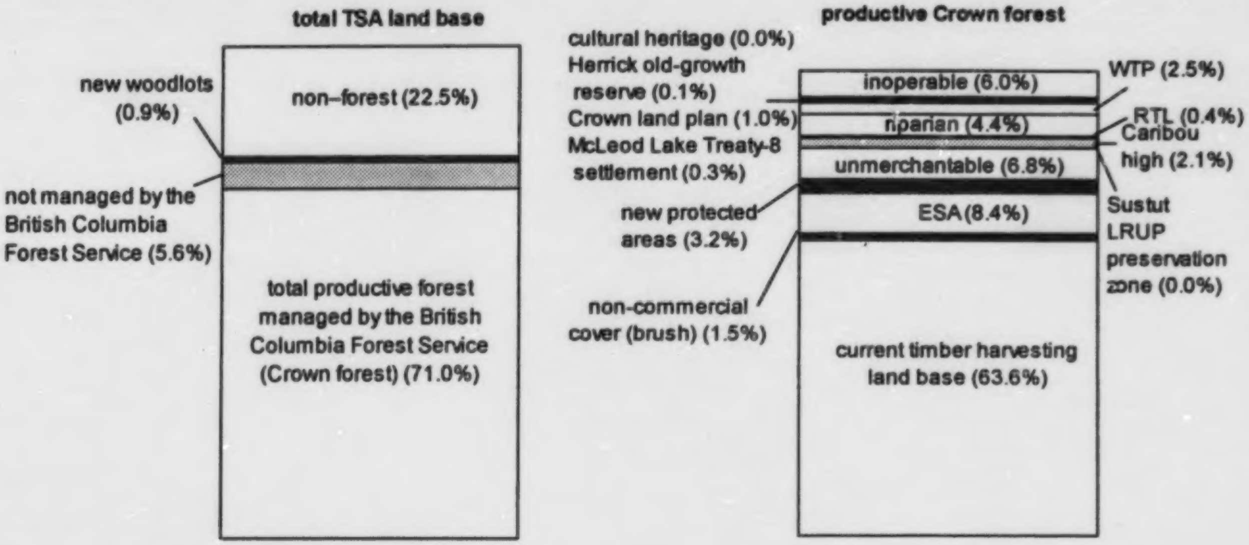
A more detailed description of these categories, including specific criteria for removal is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 4 summarizes the areas in each category, and shows the area of the timber harvesting land base. The column "Crown forest area by classification" provides the total forested area managed by the British Columbia Forest Service within the given category. For example, while there is a total of 674 046 hectares of forested land classified as environmentally sensitive area (ESA), only 446 920 hectares were removed specifically due to environmental sensitivity. The difference arises because one area can be in more than one classification (e.g., cable areas and ESA), and the actual area deducted depends on the point at which the reduction occurs in the sequence. Table A-21. in the appendix shows these areas broken out by forest district.

Table 4. Determination of the timber harvesting land base for the Prince George TSA

Classification	Crown forest area by classification[a]	Area (hectares)	Per cent (%) of total TSA area	Per cent (%) of Crown forest area
Total TSA area		7 508 191	100.0	
Not managed by the British Columbia Forest Service		423 328	5.6	
New woodlots		67 635	0.9	
Non-forest		1 689 954	22.5	
Total productive forest managed by the British Columbia Forest Service (Crown forest)		5 327 273	71.0	100.00
Reductions to Crown forest				
Non-commercial cover (brush)	80 615	80 615	1.1	1.5
Environmentally sensitive areas (ESAs)	674 046	446 920	6.0	8.4
Inoperable — physical	27 962	15 986	0.2	0.3
Inoperable — economic	429 158	281 026	3.7	5.3
Unmerchantable — mature	568 413	317 076	4.2	6.0
Unmerchantable — immature	85 599	45 636	0.6	0.9
Sustut LRUP preservation zone	2 324	1 296	0.02	0.02
Caribou high	265 316	113 871	1.5	2.1
Roads, trails and landings (RTL)		20 759	0.3	0.4
Lakeshore and wetland reserves and management zones		56 396	0.8	1.1
Stream riparian		179 786	2.4	3.4
Wildlife tree patch (WTP)		131 877	1.8	2.5
Cultural heritage	3 114	2 030	0.03	0.04
Herrick old-growth reserve	24 650	4 481	0.1	0.08
Crown land plan	75 188	50 344	0.7	1.0
Isolated high cost cells	28 819	3 645	0.05	0.07
New protected areas	295 698	170 786	2.3	3.2
McLeod Lake Treaty 8 settlement	19 084	16 601	0.2	0.3
Total current reductions		**1 939 129**	**25.8**	**36.4**
Current timber harvesting land base		3 388 145	45.1	63.6
Future land base changes				
Future road reductions		149 300	2.0	2.8
Long-term timber harvesting land base		3 238 845	43.1	60.8

[a] The crown forest area by classification is the total area which has been identified in the available dataset. The area which is deducted from the timber harvesting land base may be less than that where only a portion of the area is removed, or where another deduction already includes area with more than one classification.

Figure 2 represents the total Prince George TSA and the Crown forested land base. The chart shows that about 5.6% of the total land base is classified as not managed by British Columbia Forest Service, and 22.5% is classified as non-forest (i.e., having very few trees). The Crown forested area chart details the categories of forest land and shows that about 36.4% of the forest land in the Prince George TSA is considered to be unavailable for harvesting. The main reasons for unavailability are environmental sensitivity (including sensitive caribou habitat), economic inoperability and unmerchantability, low productivity, and riparian reserves and wildlife tree reserves. Approximately 63.6% of the Crown forested area is considered available for timber harvesting (including not satisfactorily restocked* (NSR)).



Note: unmerchantable includes mature & immature;
riparian includes lakeshore & wetland reserves & management zones & stream riparian;
inoperable includes physical & economic & isolated high cost cells;
ESA = environmentally sensitive areas;
WTP = wildlife tree patches;
RTL = roads, trails and landings.

Figure 2. Composition of the total and Crown forested land bases — Prince George TSA, 2001.

Not satisfactorily restocked (NSR) areas
An area not covered by a sufficient number of well-spaced tree stems of desirable species. Stocking standards are set by the British Columbia Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.

Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.

Figure 3 and Table 5 show the distribution of biogeoclimatic (BEC) variants* in the total forested area (Crown forested area plus the forested portions of parks) and in the timber harvesting land base. Also shown is the proportion of each BEC variant that is outside of the timber harvesting land base. For example, the SBSmk variant makes up 16.3% of the total forested area and 19.5% of the timber harvesting land base, while 24% of the total area of SBSmk is outside of the timber harvesting land base. The numbers in the last column of Table 5 suggest that the forest outside the timber harvesting land base may be sufficient to meet old-seral requirements in the longer term if it is well–distributed among the landscape units and is allowed to grow undisturbed.

Table 5. Summary of biogeoclimatic zone areas — Prince George TSA, 2001

Biogeoclimatic ecosystem classification (BEC) zone/variant	Per cent (%) of total forested area in BEC variant	Per cent (%) of timber harvesting land base in BEC variant	Per cent (%) of BEC variant that is outside the timber harvesting land base (forested only)
AT	1.09	0.25	85
BWBSdk	0.90	1.04	27
ESSFmc	4.19	2.25	66
ESSFmm	0.04	0.00	97
ESSFmv	11.70	11.59	37
ESSFwc	0.03	0.00	100
ESSFwk	8.69	3.48	75
ESSFwv	0.50	0.25	68
ICHmc	0.24	0.18	52
ICHvk	1.78	0.93	67
ICHwk	0.53	0.35	58
SBPSdc	0.26	0.31	25
SBPSmc	0.95	0.54	64
SBSdk	3.88	3.97	35
SBSdw	13.85	15.79	28
SBSmc	13.13	15.02	28
SBSmh	0.19	0.05	85
SBSmk	16.26	19.49	24
SBSmw	0.40	0.45	28
SBSvk	5.79	6.00	34
SBSwk	15.04	17.68	26
SWBmk	0.54	0.37	57
Total	100.00	100.00	Not applicable

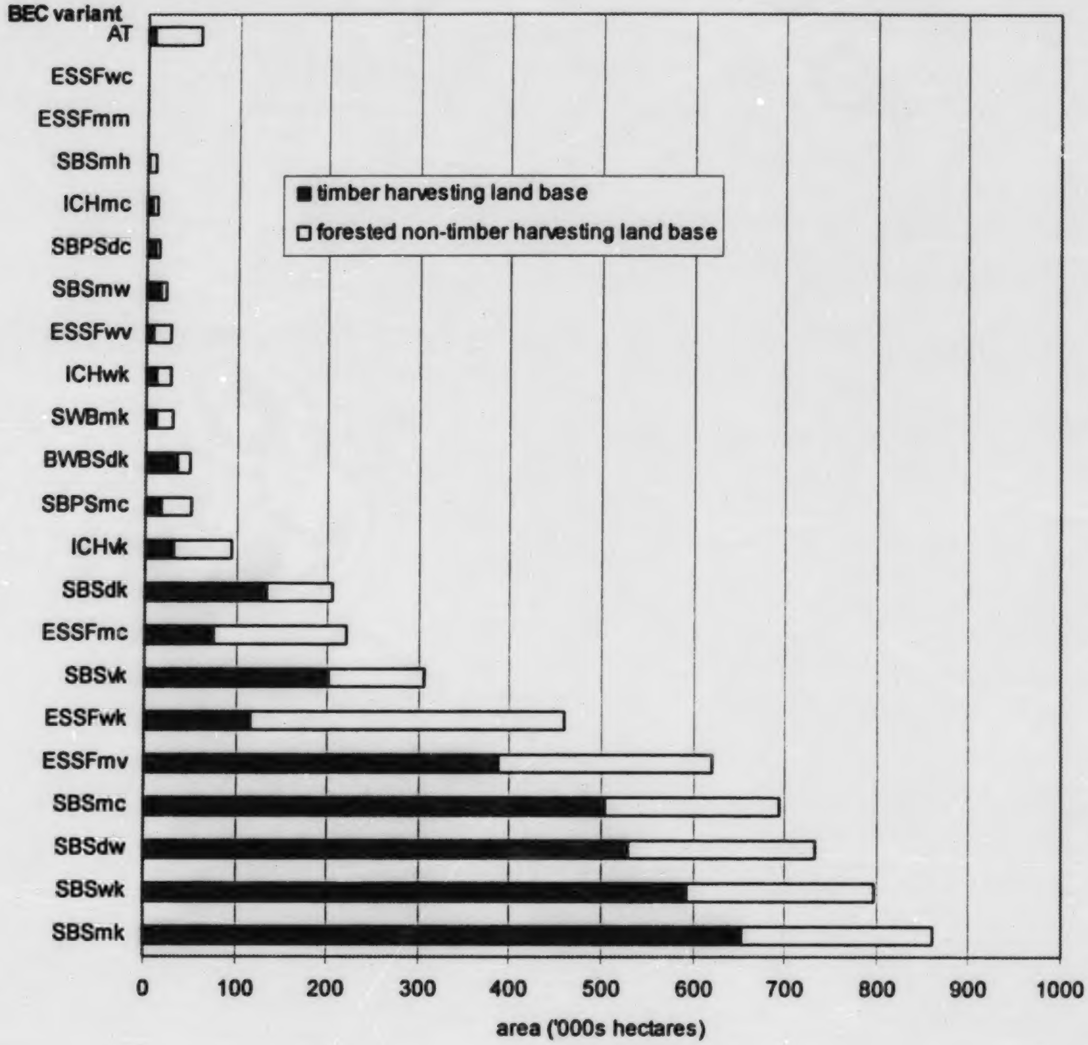


Figure 3. Area by biogeoclimatic classification — Prince George TSA, 2001.

Figure 4 shows the current composition of the timber harvesting land base by analysis unit*. Lodgepole pine species dominate stands on about 50% of the timber harvesting land base, with better site spruce dominating on 23%, and poorer spruce 6%. Balsam stands dominate on 10% of the land base and high elevation ESSF stands (a mixture of mainly balsam with some spruce) dominate on 9%) A minor amount of cedar and hemlock-leading stands exist but these are less than 1% of the total timber harvesting land base. The later ESSF stands are distinguished by slower growing sites with longer regeneration delay periods. After harvest, most stands are generally expected to be regenerated to the same species.

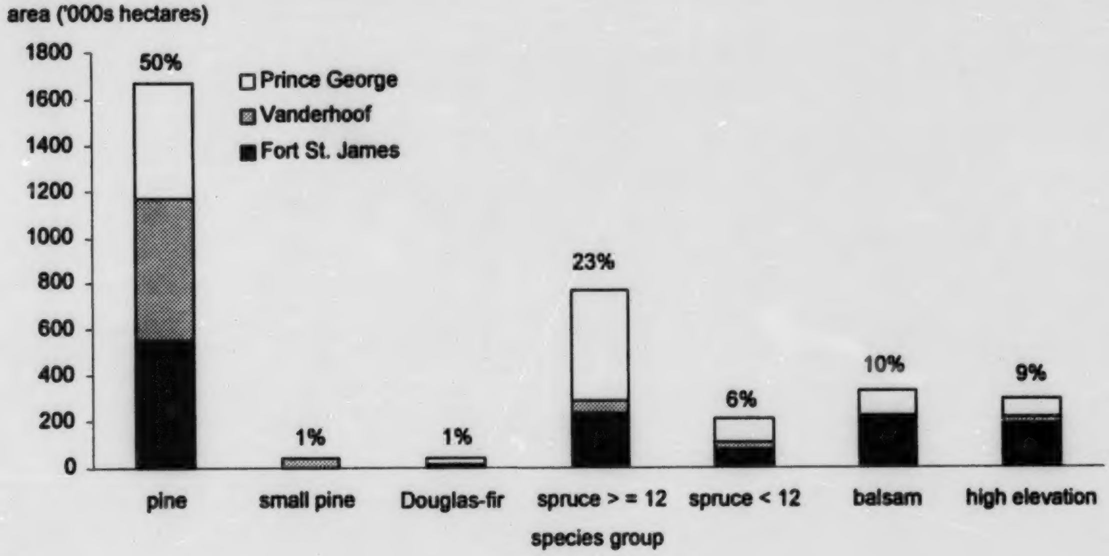


Figure 4. Area by analysis units — Prince George TSA timber harvesting land base, 2001.

Figure 4 also shows the proportion of area of each species that is in each forest district. Pine stands are almost equally distributed amongst the three districts but they dominate the Vanderhoof Forest District while the majority of spruce stands are found in the Prince George Forest District. The bulk of the stands where balsam is the major species are found in the Fort St. James Forest District. As shown further, a large proportion of the pine stands are mature, putting them at risk to attack from mountain pine beetle.

Analysis unit
A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.

Figure 5 shows the current age composition of forested stands in the Prince George TSA. This age class distribution is considered a fairly even age distribution. Only 7% of the timber harvesting land base is occupied by stands older than 250 years. About 11% of the area is covered with stands 20 years or younger, 23% is between 21 and 100 years old, and 59% is between 101 and 250 years of age.

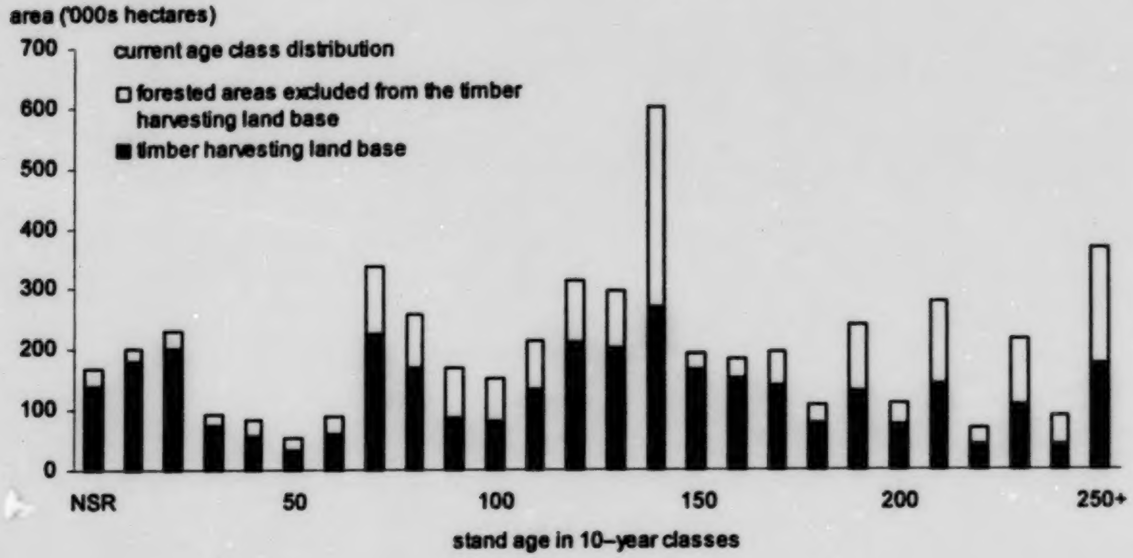


Figure 5. Current age class composition — Prince George TSA forested land base, 2001.

The age class distribution of forested stands excluded from the timber harvesting land base also affects timber supply. Although they do not contribute directly to timber supply, these areas can affect how much harvesting can be conducted and the pattern of the harvesting within the TSA by providing old-forest and biodiversity attributes. The total forested land base in the Prince George analysis area, which includes some land not managed by the British Columbia Forest Service, is approximately 5 327 273 hectares. A significant portion of the total forest area — 36.4% — does not contribute to the timber harvesting land base. About 10% of the "non-timber harvesting land base" area is older than 250 years. Only 4% of the area is 20 years or younger, 23% is between 21 and 100 years old, and 63% is between 101 and 250 years of age.

In the longer term, the non-timber harvesting land base may be able to provide most of the area needed to meet old-forest biodiversity requirements provided this forest is allowed to age without disturbance and is well distributed among the landscape units in the Prince George TSA.

2.2 Timber growth and yield

Two growth and yield models were used to estimate timber volumes for the Prince George TSA analysis. The variable density yield prediction (VDYP) model developed by the British Columbia Forest Service, Resources Inventory Branch, was used for estimating volumes in unmanaged coniferous stands. The table interpolation program for stand yields (TIPSY), developed by the British Columbia Forest Service, Research Branch, was used to estimate yields for coniferous managed stands. TIPSY was also used to estimate yields from stands that were harvested during the past fourteen years but managed to current standards. Stands harvested prior to 1987 are considered unmanaged.

Timber volume estimates* assume a specific utilization level, or set of dimensions, which establish the minimum sizes of trees and logs that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters both near the base and the top of a tree as well as a maximum stump height.

Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" contains details on the definition of managed stands, utilization standards and the specific model versions used.

Volume estimation and prediction are subject to uncertainty due to uncertainties in inventories which form the basis for estimating site productivity, limited experience with second-growth in British Columbia, and the long time frame over which trees grow. Sensitivity analyses described in Section 5, "Timber Supply Sensitivity Analyses," address the possibility that actual timber volumes may be different from estimates used in this analysis. There may be some risk associated with the spruce volumes from existing natural stands in the Prince George Forest District part of the TSA based on results from two recent VRI phase two (inventory audit) studies.

Based on timber volume estimates, the current timber inventory on the timber harvesting land base is approximately 713 million cubic metres. About 664 million cubic metres, or 93.1% of the total, are currently merchantable; that is, older than minimum harvestable age.

2.3 Management practices

Timber supply depends directly on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis process. The *Forest Practices Code of British Columbia Act* and associated regulations guide forest management practices in the Prince George TSA. The focus of the timber supply review is to assess timber supply based on current management practices as implemented for the area. Current management is described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis"). Staff in the Prince George, Vanderhoof and Fort St. James Forest Districts provided descriptions for the following management practices:

- Silviculture — reforestation activities required to establish free-growing* stands of preferred and acceptable tree species. Most areas in the Prince George TSA are harvested using a clearcut (with reserves)* harvesting system and restocked by planting or natural regeneration.

Volume estimates (yield projections)
Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.

Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Clearcutting with reserves
A variation of the clearcut silvicultural system in which trees are retained, either uniformly or in small groups, for purposes other than regeneration.

- Forest health and unsalvaged losses* — timber losses to fire and pest (insect) damage are expected to average 353 800 cubic metres per year over the 250 year analysis horizon.
- Utilization levels — minimum sizes of trees, and logs to be removed during harvesting.
- Cutblock* adjacency and green-up* — in the Prince George TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up (three metres in height for integrated forest management area), before adjacent stands may be harvested. The purpose of the cutblock adjacency* guideline is to prevent timber harvesting from becoming overly concentrated in an area. These guidelines were modelled by limiting the area within the integrated resource management (IRM)* zones that does not meet green-up conditions to a maximum of 25%.
- Maintenance of scenic values — maintaining important scenic values requires that visible evidence of harvesting must be kept within limits in some areas of the Prince George TSA. The maximum proportion of each scenic area that may be covered by young stands that do not meet green-up requirements (five metres in height) varies depending on the forest characteristics, the visual quality objectives (VQO) and the visual absorption capability (VAC) for each area, ranging between 4% and 33%.
- Maintenance of Vanderhoof LRMP special resource management zone (SMZ) — a maximum of 20% of the forested area in this zone is allowed in stands that are less than 3 metres in height.
- Protection of environmentally sensitive areas — areas where sensitive soils, recreation values and forest regeneration problems have been identified. To maintain ecological or other valuable resource values, land has been partially or wholly removed from the timber harvesting land base.
- Caribou medium habitat and corridors — areas where caribou habitat has been classified as medium are to retain 33% of their stands older than 160 years at all times. Areas identified as caribou corridors allow harvested areas to make up a maximum of 20% of the forested land base and always to maintain 20% in stands over 100 years old.
- Aleza Lake Research Forest — at least 25% of old stands (greater than 110 years) are to be retained at all times.
- Herrick Forest Ecosystem Networks (FEN) — The Herrick LRUP requires that in forest ecosystem networks 25% of the forested land base must be maintained in stands aged 120 years and older.

Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.
Cutblock
A specific area, with defined boundaries, authorized for harvest.
Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.

Cutblock adjacency
The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.
Integrated resource management (IRM)
The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

- Minimum harvestable ages (MHA) — the time it takes for stands to grow to a merchantable condition. Spruce stands are considered harvestable when they reach 101 years. Pine stands generally reach merchantable size by the time they are 81 years old. Douglas-fir, cedar and hemlock are considered merchantable at 111 years and balsam (abies spp.) at 121 years. Even though deciduous-leading stands are not currently considered merchantable, evidence from other surrounding TSAs was used to establish a minimum harvestable age of 61 years.. Actual harvest age may be greater but not less than the minimum, and will depend on ages of other available stands, forest cover objectives and overall timber harvest targets.
- Landscape-level biodiversity* — to maintain biological diversity throughout a landscape unit, the *Forest Practices Code* specifies targets for the proportion of the area in each biogeoclimatic variant that should be covered by stands with old-forest characteristics. Within the Prince George TSA, old forest is characterized by stands greater than 140 years old except in the engleman spruce subalpine fir (ESSF) biogeoclimatic zone where old-forest characteristics are exhibited at 250 years old. Since biodiversity emphasis options were still draft, a weighted average old-seral requirement was applied in the analysis (see Section A.4.11, "Forest cover requirements" in Appendix A).

The data package for the Prince George Timber Supply Area (TSA) was released in December 1998. As a result of public input, changes were made to the data package (e.g., addition of caribou habitat considerations in the Fort St. James Forest District). The revised data package, which includes detailed descriptions of the management practices and the assumptions used to incorporate them into the analysis, is presented in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" of this document.

Landscape-level biodiversity
The Landscape Unit Planning Guide provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.

Figure 6 shows the timber harvesting land base proportioned by forest management objectives. Areas with more than one objective are also indicated. An area managed for an objective such as wildlife habitat includes non-timber harvesting land base as well as timber harvesting land base. The percentages shown in Figure 6 are only for the timber harvesting land base portion of that management objective.

A large proportion of the land base (88%) falls under normal integrated resource management.

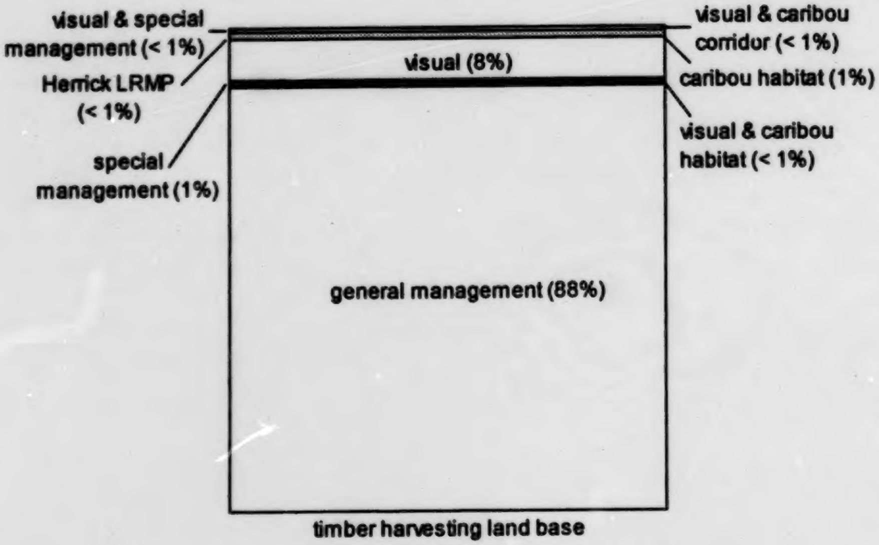


Figure 6. Timber harvesting land base by management emphasis — Prince George TSA timber harvesting land base, 2001.

2.4 Changes since the 1995 Prince George TSA analysis

The objective of this section is to present the major changes to the land base and forest management assumptions* since the last analysis.

The current timber harvesting land base is approximately 233 000 hectares smaller in this analysis compared to 1995. This is due mainly to the new protected areas, the recognition of several highly sensitive caribou habitat areas including some in the Fort St. James Forest District, and the recognition of the Crown land plan in the Vanderhoof and Prince George Forest Districts.

The current timber harvesting land base is also reduced by approximately 20 800 hectares which was signed over to the McLeod lake band as part of the provisions of Treaty 8.

As well, approximately 68 000 hectares of land base have been removed from the TSA in support of the woodlot program.

Implementation of LRMP's for Prince George, Vanderhoof, Fort St. James, and particularly Vanderhoof has increased forest cover constraints on the timber harvesting land base by adding special management zones and caribou habitat.

Implementation of the *FPC* has increased land base reductions for riparian reserves and management zones. Stand-level biodiversity is accommodated through the retention of wildlife tree patches. In this analysis the effect of wildlife tree patch retention was modelled by removing forested land from the timber harvesting land base. Additional constraints, which also often limit the availability of the timber harvesting land base, include requirements to maintain (or recruit) suitable areas of old forest for landscape-level biodiversity.

In summary, the timber harvesting land base has decreased by 6.4% and some modelling assumptions have changed since the last analysis. Given the extent of these changes, direct comparisons between this and the previous analysis cannot be made. Each analysis needs to be evaluated in the context of the management regime and related data inputs and assumptions that apply at the time. As noted in the introductory section, there is uncertainty surrounding information used in analyses, and forest management objectives change over time, which is why the *Forest Act* requires the chief forester to review the timber supply and AAC for each TSA periodically.

Any changes to the land base or management assumptions that occur or become effective after the completion of this timber supply analysis will be presented to the chief forester for consideration during the AAC determination, if possible.

Management assumptions
Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

3 Timber Supply Analysis Methods

The purpose of this analysis is to examine both the short and long-term timber harvesting opportunities in the Prince George TSA, in light of current forest management practices. A timber supply computer simulation model developed by the British Columbia Forest Service (FSSIM version 3.0) was used to aid in the assessment. A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in determining how a whole forest (collection of stands) could be managed to obtain a harvest forecast* (supply of timber over time). The simulation model uses information about the timber harvesting land base, timber volumes and the management regime to represent how trees grow and are harvested over a long period of time. Generally, only the results for the first 250 years are shown graphically in this report because the harvest level remains constant after that time.

Similar to other models, the British Columbia Forest Service model assumes that trees grow according to provided yield projections and are harvested according to either a volume target or a specified objective set by the analyst. The Forest Service model also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of green-up and old-forest prescriptions. For example, guidelines might specify that no more than some maximum percentage of the forest can be younger than a specified green-up age or that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The British Columbia Forest Service simulation model facilitates examination of the effects of such guidelines on timber supply.

This type of analysis is used to determine the timber supply implication of a particular management regime. The results of the analysis are especially important in determining allowable cuts that will not restrict options of future resource managers, and that will assist local British Columbia Forest Service staff to administer their programs according to relevant guidelines and principles. However, the results of the analysis are not meant to be taken as recommendations of any particular AAC.

The main results of the analysis are forecasts of potential timber harvests and timber inventory changes (ages and volumes) over time. Although this information gives field staff only limited guidance in the design of operational activities such as harvesting block location and silviculture planning, it does help ensure that the timber harvest level supports sustainable forest management in the field.

Harvest forecast
The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.

4 Results

This section presents results of the timber supply analysis for the Prince George TSA. The base case harvest forecast* uses the most recent assessments of current forest management, the land available for timber harvesting, and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis." The impacts of uncertainty in the inputs to the analysis will be discussed in Section 5, "Timber Supply Sensitivity Analyses." The base case provides only a part of the timber supply picture for the Prince George TSA, and should not be viewed in isolation of the sensitivity analysis*.

Section 2.4, "Changes since the 1995 Prince George TSA analysis," provides an overview of the major changes to the land base and management assumptions since the last analysis. As noted in that section, any comparison between this and the last analysis should be made with recognition of the extent and nature of those changes. Each analysis should be evaluated in the context of the management regime and related data inputs and assumptions that applied at the time. Finally, one of the major reasons the chief forester is required under the *Forest Act* to periodically review the timber supply and AAC is to account for changes in management, information and knowledge.

Base case harvest forecast
The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.

4.1 Base case harvest forecast

The base case harvest forecast for the Prince George TSA represents current management as described in the various sections of Appendix A of this report. Figure 7 shows the base case harvest forecast for the Prince George TSA. The initial harvest level is 9 073 661 cubic metres per year, which consists of the current AAC of 9 363 661 cubic metres per year, less 390 000 cubic metres per year that has been allotted to new woodlot licences (100 000 cubic metres per year) and salvage of hemlock looper damaged cedar and hemlock stands (290 000 cubic metres per year) plus 100 000 cubic metres per year for a sustainable harvest from cedar and hemlock stands. An annual harvest level of 9 073 661 cubic metres can be maintained for seventeen decades before declining by 3% to the long-term harvest level* of 8 800 000 cubic metres per year. The base case is net of a non-recoverable loss of 353 800 cubic metres per year which is deducted for each year of the analysis.

Sensitivity analysis
A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.
Long-term harvest level
A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

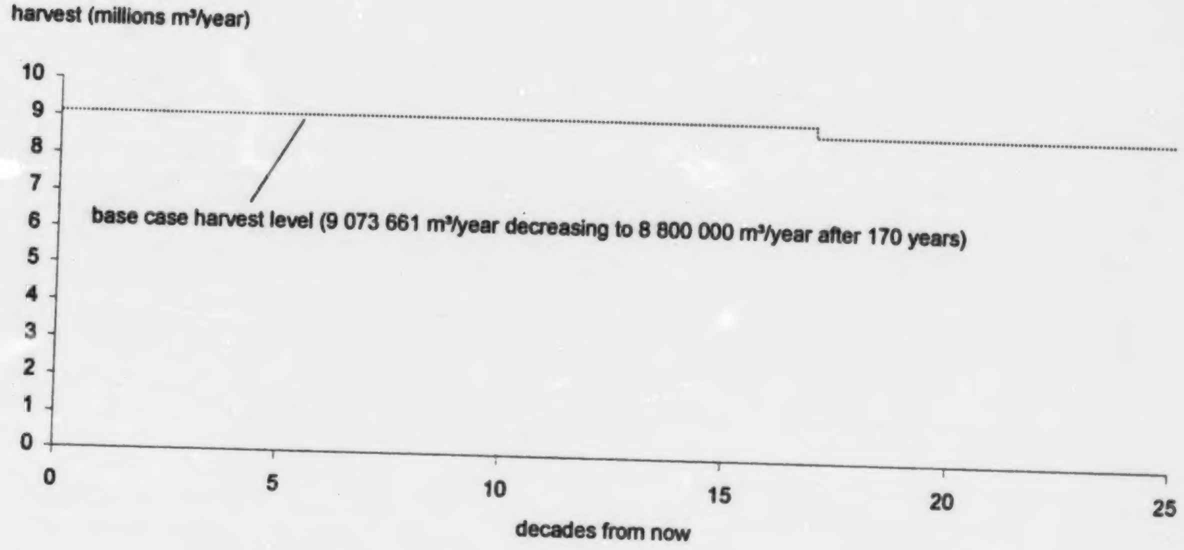


Figure 7. Base case harvest forecast — Prince George TSA, 2001.

4 Results

In the short- and medium-term the harvest forecast for this TSA depends on existing timber growing stock*. Figure 8 shows a projection of timber inventory volumes over time corresponding to the base case harvest forecast. Total growing stock on the timber harvesting land base declines over the next 13 decades from about 713 million cubic metres as the oldest of the existing mature stands are harvested and replaced by younger, second-growth stands. Over the long term, the total growing stock for the base case averages about 380 million cubic metres.

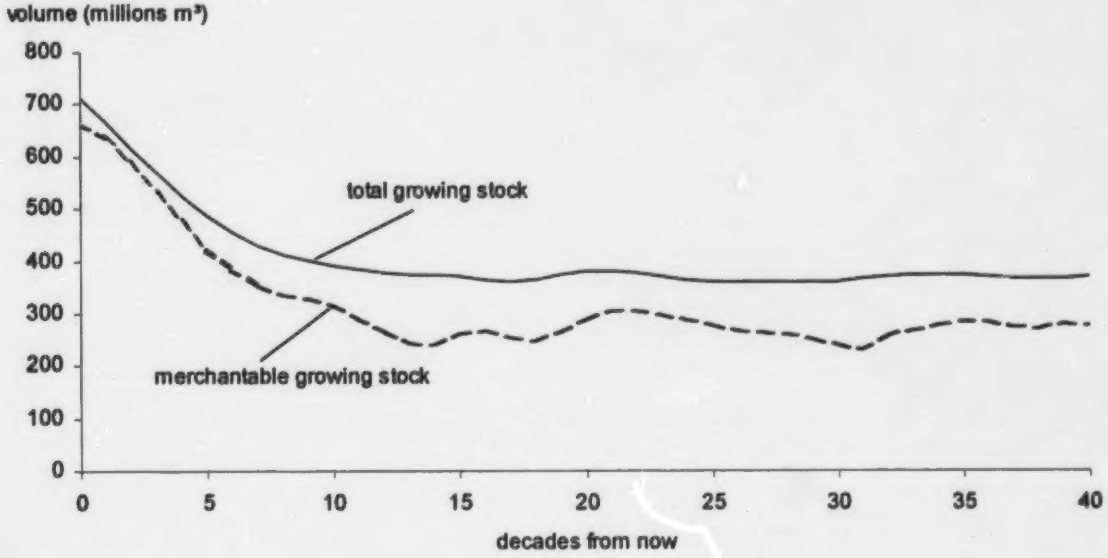


Figure 8. Total, merchantable and available growing stocks — Prince George TSA, 2001.

Initially about 664 million cubic metres, or 93% of the total growing stock, is currently merchantable, ie. older than minimum harvestable age. The average merchantable growing stock over the long term is about 272 million cubic metres. Even though timber may be merchantable it may not be available for harvesting because it is required to satisfy other resource requirements, such as caribou habitat, as defined in Appendix A.

The base case long-term harvest level of 9 073 661 cubic metres per year is the harvest rate that can be achieved while maintaining the total timber growing stock on the timber harvesting land base at an even level, on average, over the long term. An even-growing stock indicates that harvesting can continue at the corresponding harvest level in perpetuity. A continually increasing growing stock would indicate that the timber is being harvested below the productive capability of the land. A continually declining growing stock would signify that the timber is being harvested above the productive capability of the land.

Growing stock
The volume estimate for all standing timber at a particular time.

Figure 9 shows the transition of harvesting from existing to managed stands, and the amount that each makes up in the base case forecast. For the first nine decades the harvest depends fully on existing stands, and then during decades 10 through 15 the harvest becomes increasingly dependent on managed stands. The high volume of existing merchantable growing stock allows harvesting to occur in this TSA at the long-term level until managed stands become merchantable.

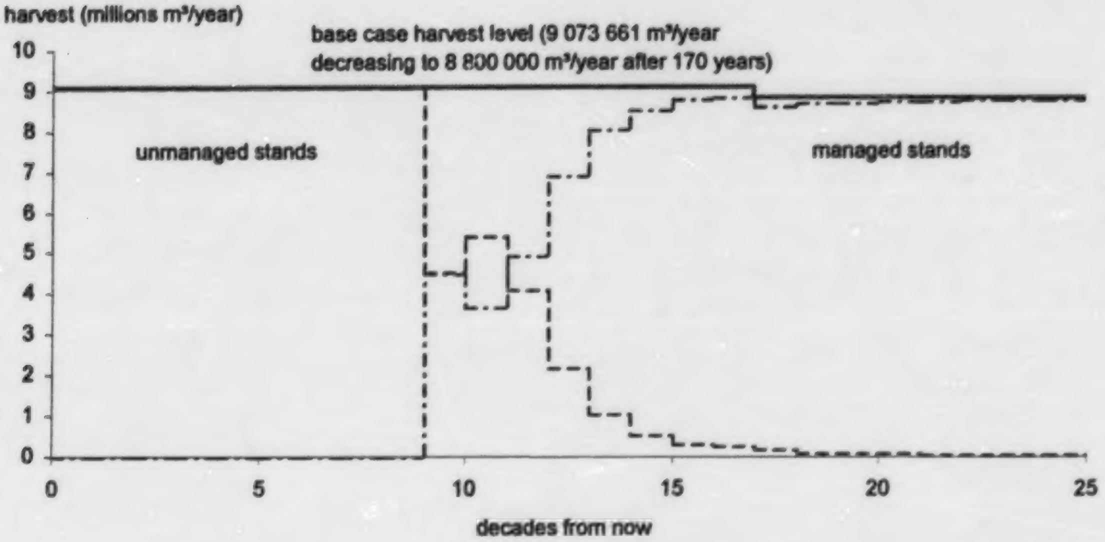


Figure 9. Harvest contribution from existing and managed stands — Prince George TSA, 2001.

4.2 Average age, area, and volume harvested

Figure 10 tracks the change in average harvest age resulting from the base case forecast. The average age is calculated based on weighting by stand area. Initially the harvest comes from the oldest stands in the timber harvesting land base. During the first 100 years of the forecast, the average harvest age is about 180 years. From decade 10 onward, managed stands comprise more of the forecast harvest, and the average age of the harvested stands declines to approximately 100 years. There are some areas of the TSA (VQOs, landscape corridors) where the rate of harvesting is very slow. This, combined with a harvest rule which schedules the relative oldest stands to be harvested first, can distort the area-weighted average harvest age.

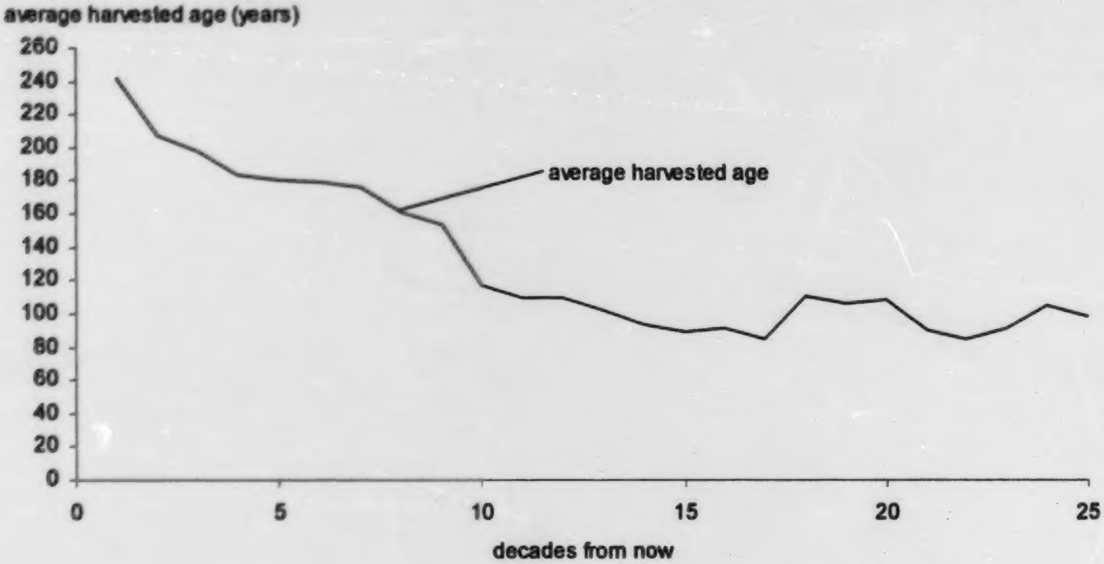


Figure 10. Average age of stands harvested over time — Prince George TSA base case, 2001.

Figure 11 shows the average volume harvested per hectare per year over the next 250 years under the base case harvest forecast. For the first nine decades, while the timber supply is forecast to come mainly from unmanaged stands, the average volume per hectare varies from 330 to 350 cubic metres per hectare. After decade 10 when the timber supply is forecast to come mainly from managed stands, the average volume per hectare gradually decreases to a low of 250 cubic metres per hectare during decade 17 before recovering to a long-term average of about 280 cubic metres per hectare. Figure 11 also shows the average area harvested. Over the first nine decades the average area harvested is fairly stable at 28 000 to 29 000 hectares per year. For the following 15 decades, during the time that harvests are mainly from managed stands, the average area harvested fluctuates from a low of 28 000 hectares in decade 24 to a high of 37 000 in decade 18 (these areas include accounting for non-recoverable losses, at a level generally over 1,000 hectares per year). In the long term, the average area harvested per year is about 33 000 hectares.

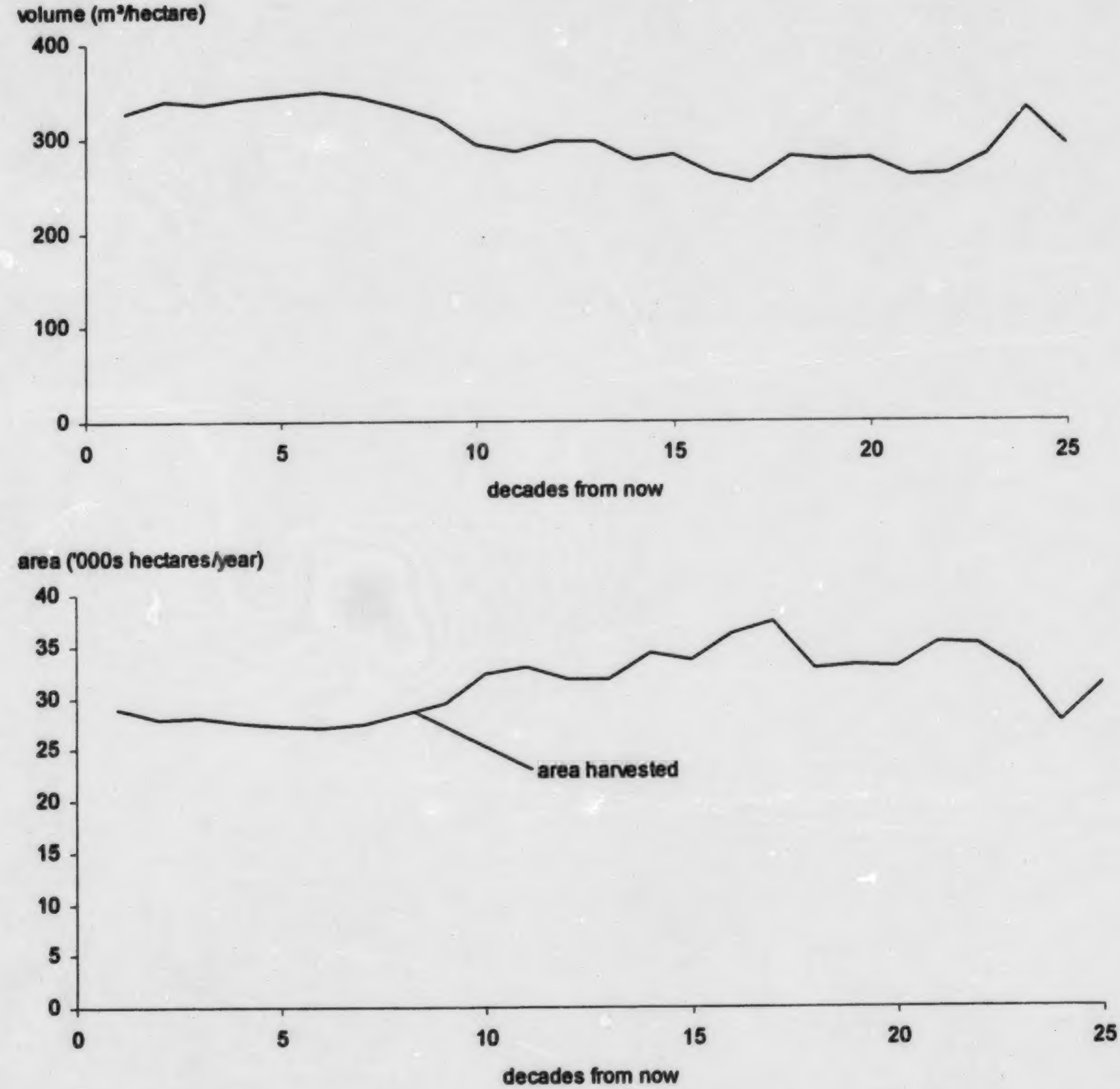


Figure 11. Average area and average volume per hectare harvested over time — Prince George TSA base case, 2001.

4.3 Age class profile over time

The charts in Figure 12 show how the age composition of the Prince George TSA productive forest land base changes over the next 250 years under the base case harvest forecast..

There are approximately 5 327 000 hectares of productive forest land base within the Prince George TSA analysis area, of which 3 388 000 hectares (64%) support timber harvesting.

The current age class distribution shows that stands within the timber harvesting land base are not evenly distributed, with a significant portion (45%) of the stand ages at least 140 years old, and few stands (less than 6%) above 250 years old. Stands aged less than 40 years old make up 19% of the total timber harvesting land base. These younger stands are associated with past harvesting.

The same general distribution of age classes applies to the non-timber harvesting land base. Most of those stands (93%) are 70 years and older. The stand younger than 70 years on the non-timber harvesting land base stands generally originate from natural and human-caused wildfires. The non-timber harvesting land base has 10% in stands aged 250 years and greater (compared to less than 6% for the timber harvesting land base). As can be seen from this series of graphs the non-timber harvesting land base continues to age as the simulation proceeds. In reality this forest would likely suffer the same natural disturbance events as it did in times past. A sensitivity analysis was done where the non-timber harvesting land base stands are recycled upon reaching a certain maximum age. This analysis is presented in Section 5 “Timber Supply Sensitivity Analyses”.

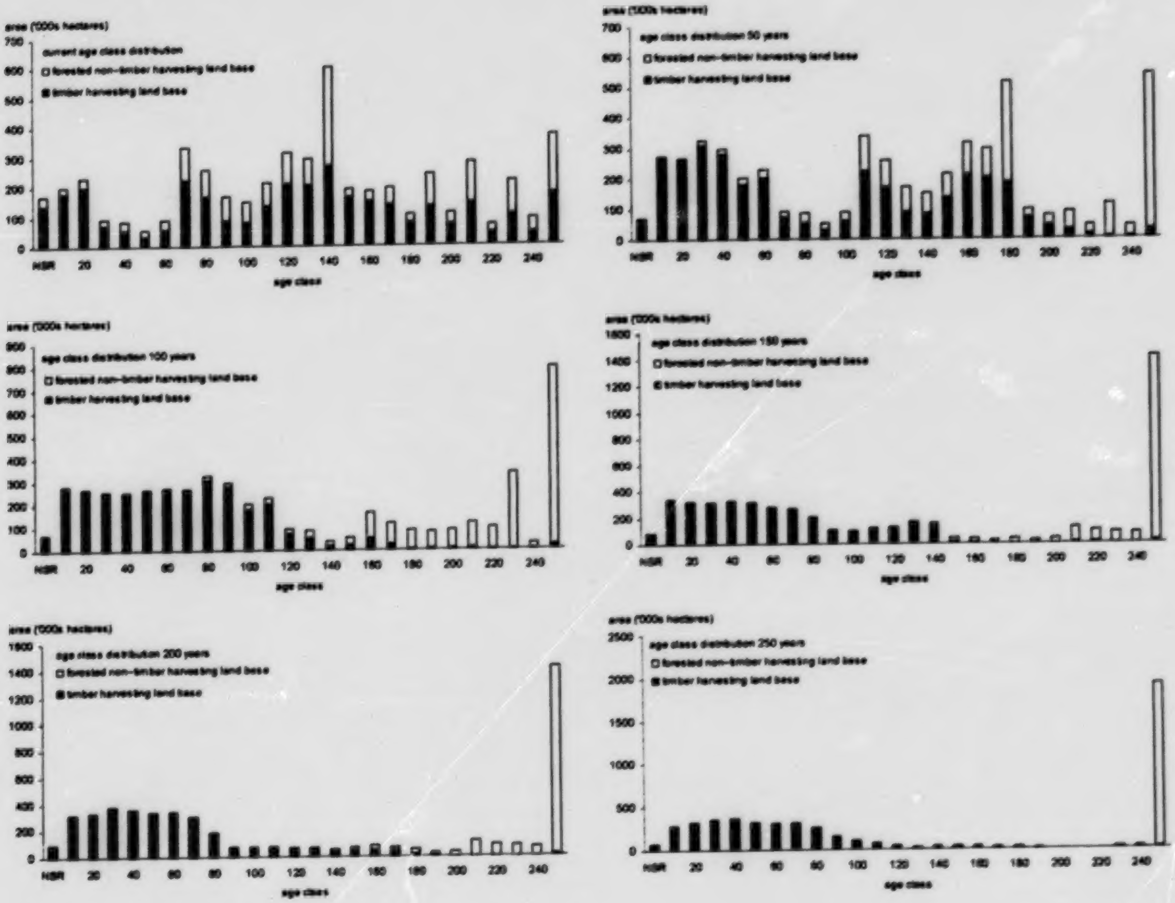


Figure 12. Changes in age composition on the productive land base over time — Prince George TSA base case, 2001.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyze the timber supply implications of continuing with current management. However, forest management is complicated since it must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human time spans, so that decisions we make today have not only short-term but also long-term effects beyond the life spans of current decision makers. In such a context, we cannot be certain that all the data accurately reflect the current state of all values in the forest, how the forest will change, or how our management activities will affect the forest.

One important way to deal with this uncertainty is to revise plans and analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent planning and decision-making can help minimize any negative effects that may occur if decisions are based on inaccurate information. Frequent revision can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess how values of interest, for example, timber supply, could change if the information used in the analysis is not accurate. Sensitivity analysis is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making. Sensitivity analysis can highlight that fairly small uncertainties about some variables could have large effects on timber supply projections, or conversely that fairly large inaccuracies in others could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short term than in the long term, while others have the opposite effect. Sensitivity analysis can highlight priorities for collecting information for future analyses, and show which variables, and associated uncertainties, have the most significance for decisions. It can clarify whether current best estimates provide a safe basis for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

In this section, results of several sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high *versus* low sensitivity) in the harvest forecast resulting from changes in forest management assumptions and data used in the base case.

5.1 Alternative harvest flows

There are many possible harvest forecasts with different initial levels, decline rates, and trade offs between short-, mid-, and long-term harvests. The base case harvest forecast shown in Figure 7 was defined using criteria discussed in Section 4.1, "Base case harvest forecast." The criteria generally includes managing the rate of decline in harvests from an initial level, avoiding large and abrupt harvest shortfalls, and maintaining a fairly constant growing stock level over the long term.

Figure 13 compares two alternative forecasts with the base case. All inputs related to land base, growth and yield and management remain constant in these forecasts. The first alternative shows the maximum initial harvest level which can be maintained without impacting the long-term harvest level. A harvest of 12 450 000 cubic metres per year can be maintained for one decade before declining to the long term harvest level of 8 800 000 cubic metres per year. The second alternative shows the impact of extending the elevated harvest for 40 years, with a significant mid-term decline to 6 616 000 from 90 until 130 years from now.

The growing stock impact of alternative one is shown in Figure 14.

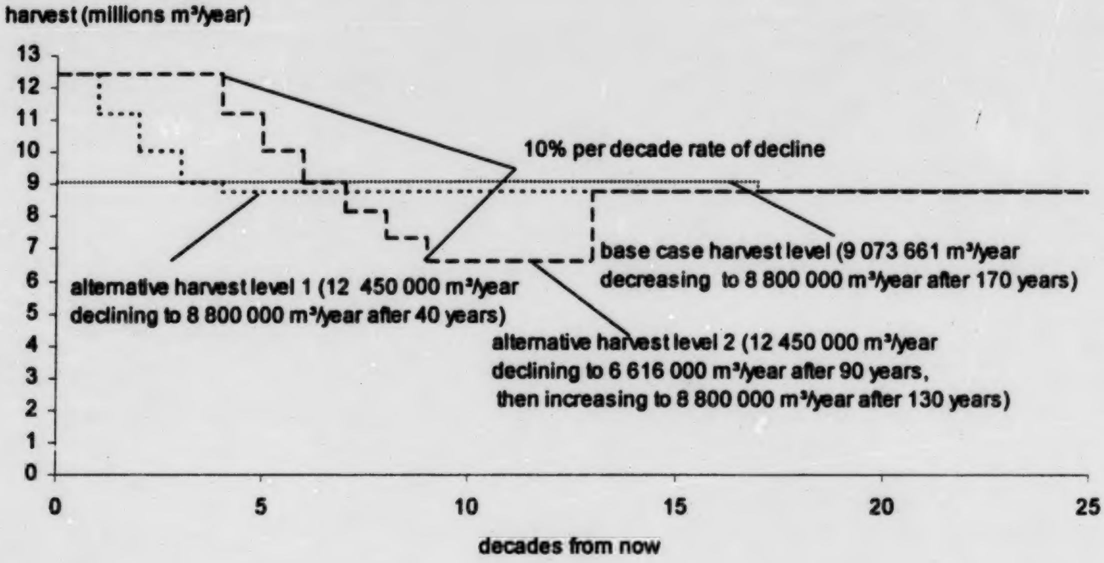


Figure 13. Alternative harvest forecasts — Prince George TSA, 2001.

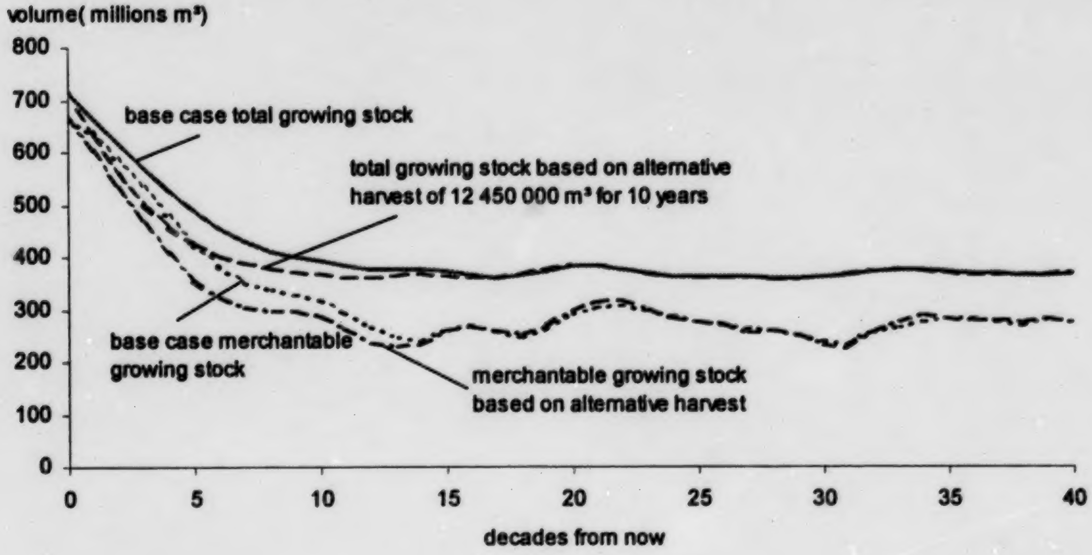


Figure 14. Growing stock comparison of the base case to alternative one — Prince George TSA, 2001

The impact of maximum initial decade harvest level declining at 10% to the long term harvest level:

Initial harvest level of 12 450 000 cubic metres per year can be maintained for 10 years before declining to the long-term level of 880 000 cubic metres per year.

Total and merchantable growing stock projections are similar to those resulting from the base case for the long term. Decline is steeper for the accelerated harvest but by 140 years the levels are virtually the same.

The impact of maintaining a maximum initial harvest level as long as possible declining at 10%:

It is possible to maintain a harvest level of 12 450 000 cubic metres per year for four decades if a mid-term level lower than the base case long-term level of 8 800 000 cubic metres per year is allowed.

This alternative enables the mid-term harvest level to decrease to a level no lower than that which equates to the long-term harvest level if existing stand yields (i.e., VDYP based) were assumed upon regeneration. The long-term harvest level of 8 800 000 cubic metres per year is achieved by decade 13.

5.2 The contribution from stands that have cedar and hemlock as the major species.

There is currently a partition of 290 000 cubic metres per year to facilitate salvage of looper damaged leading-cedar and hemlock stands in the Prince George Forest District part of the TSA. Despite several attempts to sell this volume through non-replaceable forest licences, to date commitment on only 110 000 cubic metres per year have been made. The original partition amount was based on mortality and damage estimate made from surveys done in 1994 and 1995. Since that time further surveys have been done that indicate that many of the leading-cedar stands that were thought to be severely damaged or dead have recovered. There is still a large area requiring salvage but it is much less than was estimated in the 1995 analysis.

Staff in the Prince George Forest District believe that a more sustainable level of harvest for leading-cedar and hemlock stands is more appropriate at this time. Figure 15 shows the harvest forecast expected from these stands. This analysis assumes that current regeneration management for cedar and hemlock harvested areas is to reforest mainly with nursery produced spruce seedlings and only 10% with natural germination of cedar and hemlock. There are approximately 73 600 hectares of stands where cedar or hemlock is the dominant species of which 37 900 hectares are currently considered unsuitable for harvesting due to considerations such as steep terrain, riparian buffers, tree quality, economics and environmental sensitivity. This leaves 23 700 hectares of cedar stands and 12 000 hectares of hemlock stands contributing to the timber harvesting land base and supporting this harvest forecast. The management of cedar stands is in transition in the Prince George Forest District.

If a more sustainable harvest for leading-cedar and hemlock stands is proposed

- 100 000 cubic metres per year can be maintained for five decades falling to a long-term harvest level of 85 000 cubic metres per year by decade 7.

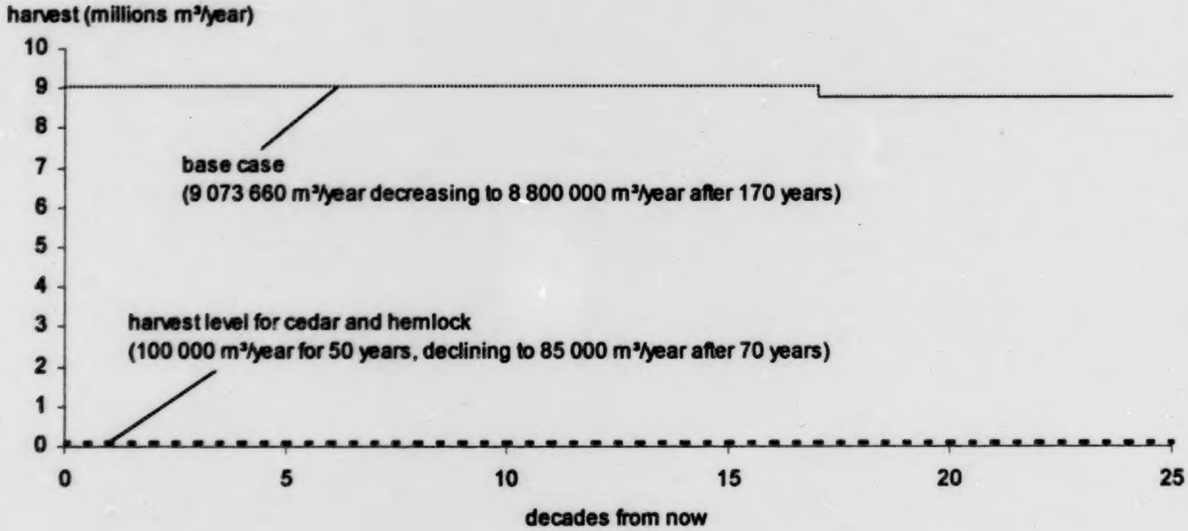


Figure 15. Contribution from cedar- and hemlock-leading stands to the base case — Prince George TSA, 2001.

5.3 The contribution of the three forest districts to the TSA harvest flow

The Prince George TSA is made up of three forest districts; the Prince George, Vanderhoof and Fort St. James. Over the last several years volume based licensees have been shifted from one district to another to address salvage due to timber being damaged by fire and insects. In the early 1980's a large portion the harvest was shifted to the Bowron Valley of the Prince George Forest District to address the spruce bark beetle epidemic. After the outbreak was over the volume was not re-allocated among districts, resulting in more harvesting in the Prince George Forest District. This sensitivity analysis examines the contribution of harvest by district in the base case to what a relatively steady state harvest might be for each district. Figure 16 shows the volume harvested by district in the base case. In this instance no restrictions were placed on the volume harvested from each district. Figure 17 shows what is achievable in terms of relatively steady state harvest level from each district.

The size of the Prince George timber supply area (TSA) has been a concern for many interest groups since its establishment in the late 1970s. More recently, discussions regarding the size of the TSA have surfaced in Land and Resource Management Plan (LRMP) negotiations that were held throughout the 1990s in all three of the forest districts within the TSA. Finally, in recent months, this issue has been raised during informal discussions with the mayor and councils of several communities and with other stakeholders in the TSA. For many, the issue is based on concerns about the location of harvesting, the flow of logs, and the location of wood processing facilities, employment opportunities and community stability. Another important consideration is whether timber supply would be affected by treating each district as a separate timber supply area. A discussion paper was released early this year that discussed the issue of the size of the TSA.

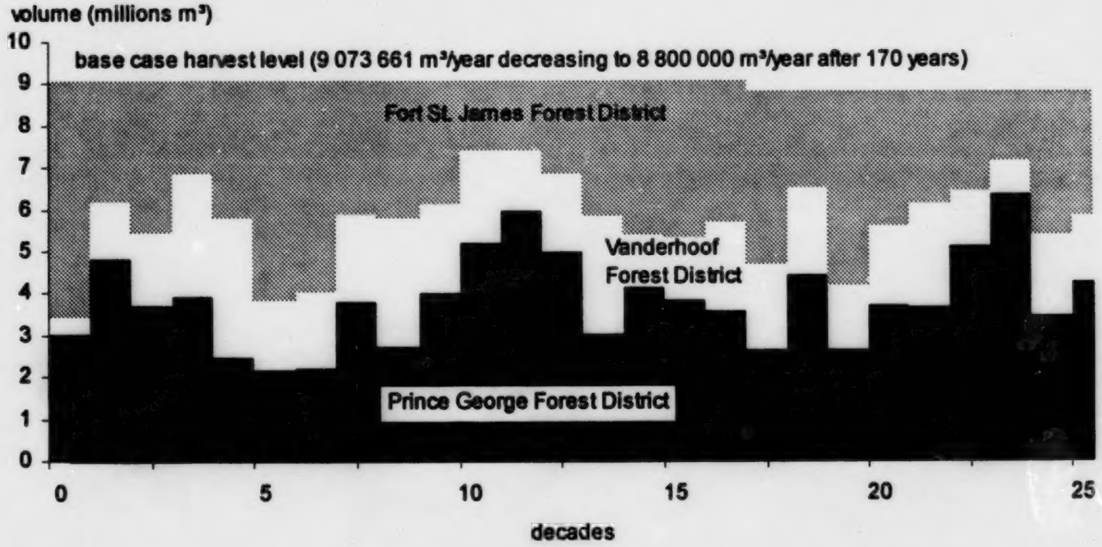


Figure 16. Contribution of the three district harvest levels to the base case — Prince George TSA, 2001.

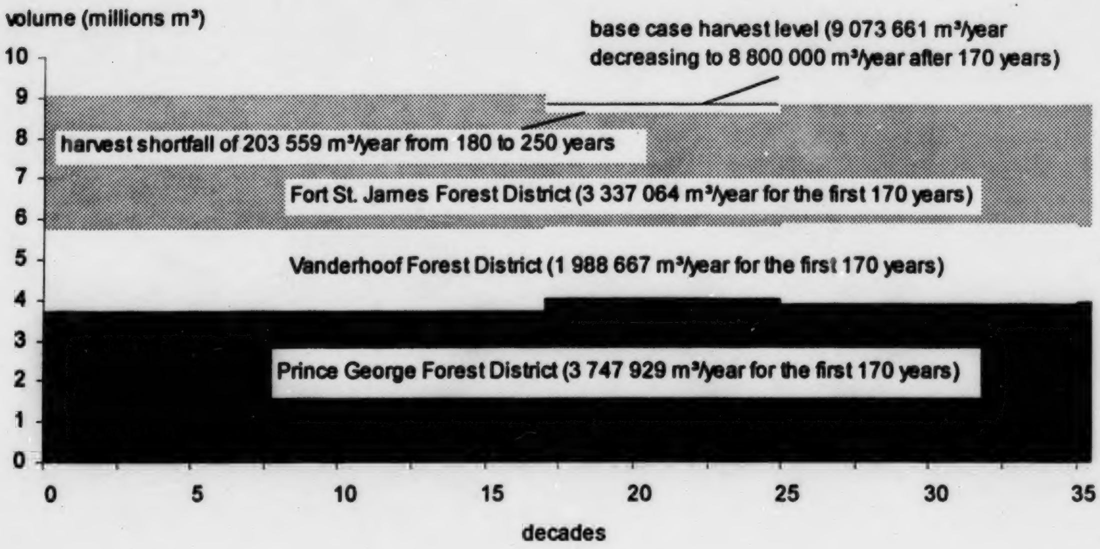


Figure 17. Steady state harvest flow by forest district — Prince George TSA, 2001.

Harvest flows by forest district

Figure 16 indicates that, given no volume targets by district, the FSSIM timber supply model draws a large portion (over 5.6 million cubic metres) of its first decade harvest from the Fort St. James Forest District. As will be seen later in Section 5.4, "Contribution of supply block A to the TSA," this is because the model works on a rule that priorizes the relative oldest timber first. The Fort St. James Forest District has the largest proportion of old timber in the TSA.

It should be noted that the combined steady state harvest flows from each district fall slightly short of what is achievable in the base case. There is a small (approximately 200 000 cubic metre per year) shortfall in the mid-term to long-term (decade 17 to 25) harvest flow.

5.4 The contribution of supply block A to the TSA harvest flow

Supply Block A is located in the remote northwest reaches of the Fort St. James Forest District part of the Prince George Timber Supply Area and is primarily undeveloped. It is a significant distance from most processing facilities in the Prince George and Prince Rupert Forest Regions. It is in closer proximity to processing facilities located in Prince Rupert Forest Region than those located within Prince George TSA.

Supply Block A is currently accessed by air or British Columbia Rail. Because of its remoteness and the high costs associated with timber harvesting, operations have been sporadic with two non-replaceable Forest Licenses having part of their operations there. During the recent Prince George TSA licensee operating area re-allocation exercise replaceable forest licensee holders could not come to consensus on operations there. The base case and one sensitivity are examined to highlight the importance of supply block A to the timber supply of the TSA.

The size of Supply Block A is 1 010 000 hectares of which 175 000 hectares (17%) is potential timber harvesting land base, which is 5.2% of the TSA timber harvesting land base. Figure 18 shows the species composition of the forested land base in supply block A. Over 125 000 hectares are stands where balsam (Abies) is the dominant species. The forest inventory indicates that the volume on stands that are mature is 45.6 million cubic metres or 6.9% of the total mature volume in the TSA. The vast majority of timber in the supply block is mature (greater than 140 years) and highly susceptible to pathogens like Balsam Bark Beetle.

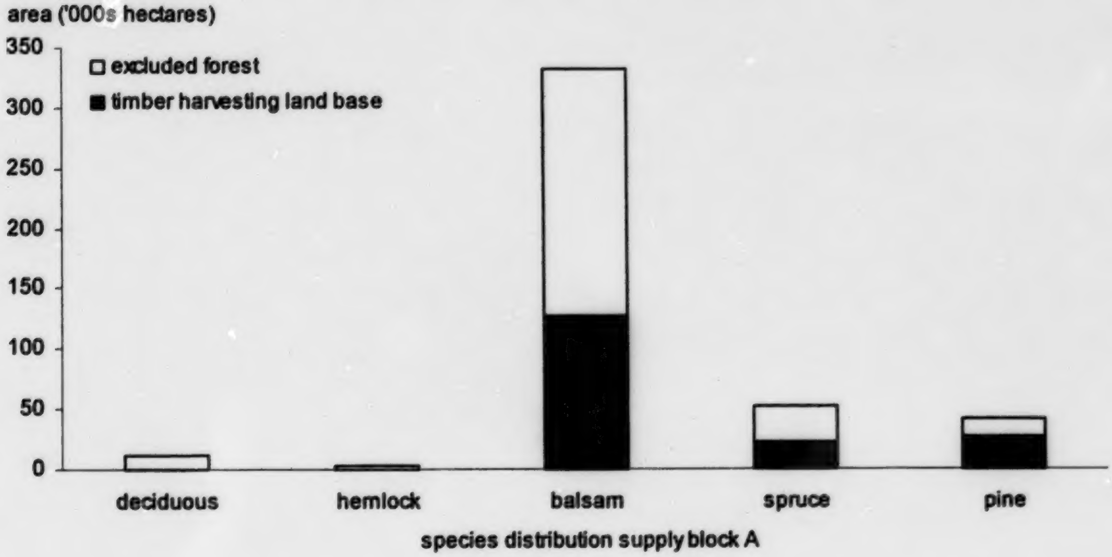


Figure 18. Species distribution of the forested land base of supply block A — Prince George TSA, 2001.

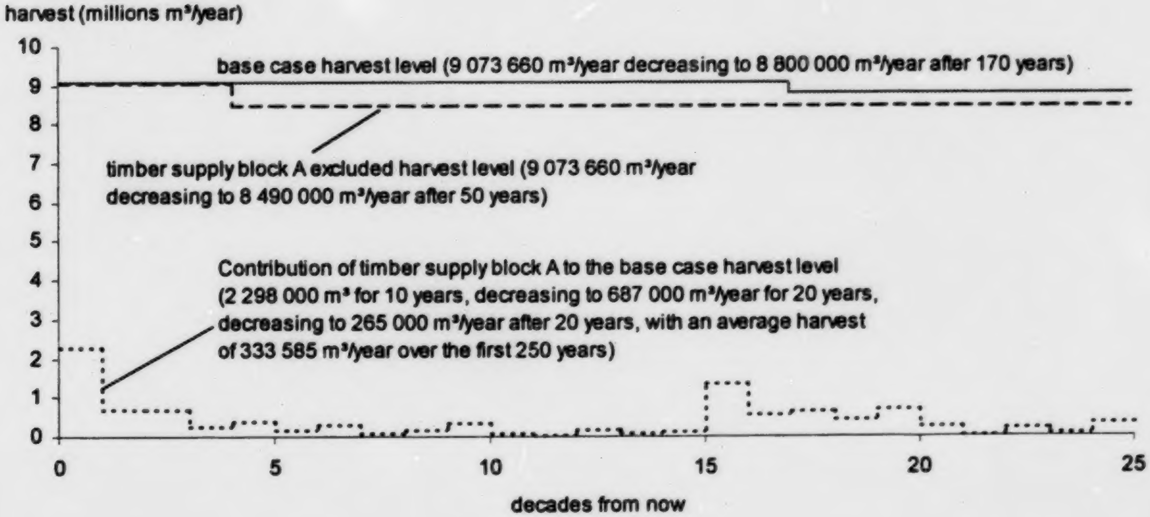


Figure 19. Base case showing the contribution from supply block A and the effect on the harvest forecast of removing supply block A — Prince George TSA, 2001.

In the base case, the highest priority for harvest was given to stands that were the oldest relative to their minimum harvestable age. This 'relative oldest first' rule was applied only after other requirements and priorities (e.g., forest cover requirements) were taken into account. This rule reflects the practice of favoring older stands, but not necessarily the oldest, for harvest when all other considerations have been met. The results of this prioritization are evident in Figure 19 that shows the contribution that supply block A makes to the base case as well as the effect of removing supply block A from the Prince George TSA

The contribution of supply block A to the TSA for the base case

- Supply block A contributes 2.3 million cubic metres per year of harvest to the base case in the first decade dropping to approximately 690 000 cubic metres per year for the next two decades (the 250 year average harvest is 333 585 cubic metres per year).
- A sensitivity analysis has shown that the first three decades harvest from supply block A can be held to 600 000 cubic metres per year with no effect on the base case.

The effect of removing supply block A from the TSA.

- There is still sufficient mature volume in the TSA to maintain the base case initial harvest level for five decades.
- The long-term harvest level is reduced 3.5% to 8 490 000 cubic metres per year.

5.5 Uncertainty in the contribution of stands where deciduous species dominate.

The current AAC for the Prince George TSA does not rely on contributions from stands where deciduous trees are the dominant species. There is increasing interest in harvesting these stands. In the last year, under the authority of the Small Business Forest Enterprise Program (SBFEP), the Prince George Forest District sold licences for approximately 30 000 cubic metres from stands where birch is the major species. Recently several proposals have been submitted to the Regional Manager for the harvest of stands where aspen is the dominant species.

There is very little history of harvest of aspen-leading stands in this TSA and thus no indication of what attributes might define an economically operable stand. This analysis has borrowed the definition from the Fort Nelson TSA where a merchantable stand is defined as those aspen-leading stands with a site index (breast height age 50) greater than 17 (a conservative estimate relative to other TSAs in the Prince George Forest Region). Based on this definition there are 61 700 hectares of potential timber harvesting land base out of a total of 194 200 hectares of aspen-leading stands. Figure 20 shows the productive forest land base associated with aspen-leading stands by site index class. Figure 21 shows the harvest forecast that results from these stands.

There are 28 800 hectares of stands where birch is the dominant species. Using the same definition of a potentially economically operable stand as is used for aspen (minimum SI breast height age 50 greater than 17.0) the potential timber harvesting land base is 13 800 hectares. 12 300 hectares of this is in the Prince George Forest District and the inventory file indicates that only 1400 hectares of this is older than 80 years. The potential harvest level from stands where birch is the dominant species is estimated to be in the 15 000 to 25 000 cubic metres per year range. This estimate is not based on any harvests simulations or computer based modelling.

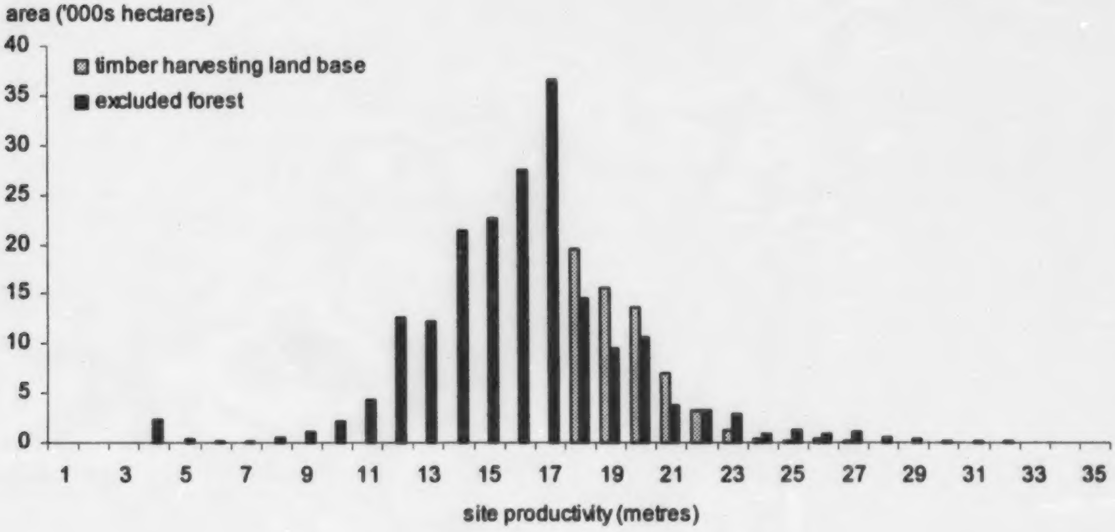


Figure 20. Productive area of aspen stands by site index— Prince George TSA, 2001.

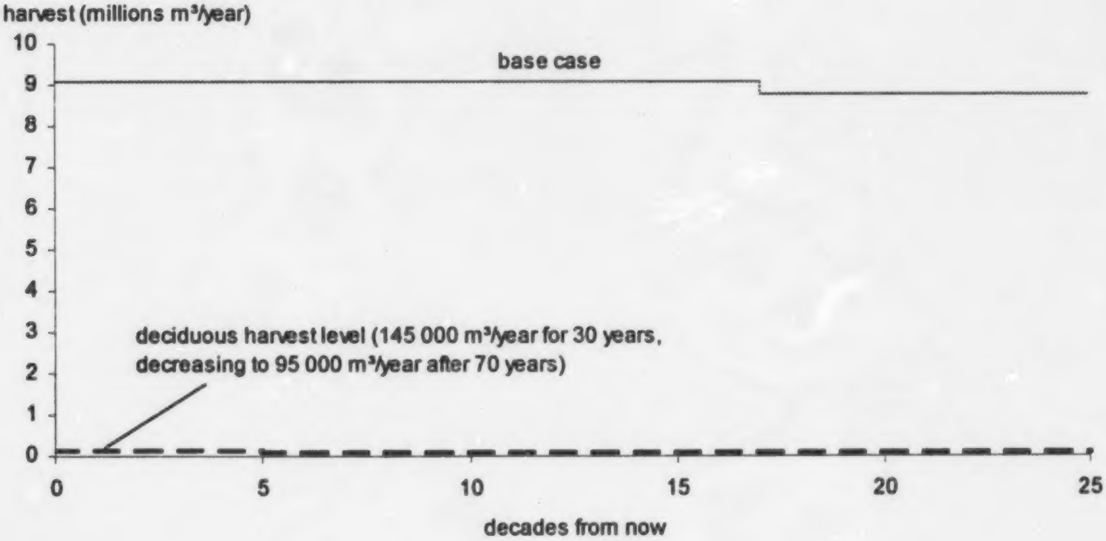


Figure 21. Harvest forecast from aspen stands — Prince George TSA, 2001.

Productive area of aspen stands by site index class

- There are 140 000 hectares of forested area that are below the timber harvesting land base cutoff. 36 600 hectares of this is in the 17 site index class. Some of these stands may be currently merchantable or economically feasible at some future time.

Harvest flow from aspen stands

- 145 000 cubic metres per year can be maintained for three decades falling at 10% per decade to a long-term harvest level of 95 000 cubic metres per year by decade 7.

A higher long-term level, and maintenance of the short-term level for a longer period, is possible if more area is included into the aspen timber harvesting land base. If land base were to be added it would be subject to all of the other netdowns such as environmentally sensitive areas, riparian buffers, and wildlife trees.

The TSA base case harvest forecast includes the minor deciduous component from stands where coniferous species dominate.

5.6 Mountain pine beetle epidemic

The central interior of British Columbia is experiencing one of the worst mountain pine beetle outbreaks in recent history. To salvage timber damaged from this outbreak AACs in the adjacent Quesnel and Lakes TSAs have been increased.

The Forest Service estimates that approximately 80% of the Prince George TSA harvest could be re-directed to address the salvage of this damaged timber. This would amount to approximately 7.5 million cubic metres of harvest annually. The Bowron Valley Spruce Bark Beetle epidemic of the 1980s was controlled and salvaged through re-directed harvesting operations of several forest licensees in the Prince George TSA.

A sensitivity analysis was done to see how much harvest could be re-directed into lodgepole pine stands without changing the overall base case harvest flow. A harvest level from lodgepole pine stands of over 7 500 000 cubic metres per year can be maintained for 20 years (a total over 150 million cubic metres of pine), without altering the overall base case harvest flow. In order to maintain harvest flow after concentrating harvest in lodgepole pine, there is limited pine harvest for the subsequent 10 years. The pine harvests by forest district for the first two decades of the harvest forecast are shown in Table 6.

Table 6. Lodgepole pine harvest by forest district for the first 20 years of the mountain pine beetle harvest forecast — Prince George TSA, 2001

Forest district	1st decade annual harvest (cubic metres per years)	2nd decade annual harvest (cubic metres per year)	20 year average annual harvest (cubic metres per year)
Prince George	1 940 000	2 866 000	2 403 000
Vanderhoof	3 500 000	2 800 000	3 150 000
Fort St. James	2 103 000	1 877 000	1 990 000
Total TSA	7 543 000	7 543 000	7 543 000

5.7 Uncertainty in the estimated existing stand yields

Timber volume estimates for existing unmanaged stands are subject to uncertainties in the forest inventory used to estimate timber volumes (i.e., estimated tree heights and stand ages), and the statistical process used to develop the equations for predicting forest growth and yield. Timber volumes are normally accurate when averaged over large areas, but may not reflect actual volumes within individual stands. Uncertainty may also arise in the estimates of the volume lost both to decay in older trees, and to waste and breakage during harvest, and of the utilization levels practiced during harvesting.

Inventory audit

During the last several years, Forest Inventory and Monitoring Branch (MSRM) has performed audits of the standing volume of trees within TSAs and TFLs across the province. These audits provide an indication of how confident we can be in estimated volumes in the management unit.

Two inventory audits have been done over the past five years in the Prince George TSA. The first audit completed in 1996 indicated that overall in the TSA the volumes for existing mature stands (defined by the audit study as greater than 60 years old) reported in the forest inventory file might be greater than the volumes found in audit ground samples. There were enough samples to stratify by forest district and perform further statistical analysis. This analysis indicated that the inventory volumes in the Fort St. James and Vanderhoof Forest Districts were not statistically different from the ground sampled volumes. For the Prince George Forest District the inventory volumes were higher than the ground volumes. These higher inventory volumes were a result of the heights of mature spruce trees being overestimated by more than 3 metres. Subsequently Canfor, the largest forest licensee in the Prince George Forest District, funded a further 80 inventory audit plots in stands where spruce was the dominant species. These plots verified the initial findings.

For the Prince George TSA, indications from the both inventory audits were that standing volumes in operable spruce stands over 60 years may be overestimated by approximately 21.2% when stems of 17.5 centimetres diameter at breast height (dbh) were considered merchantable (utilization level, Forest Inventory and Monitoring Branch has recommended a more comprehensive study be conducted before any adjustments are made to the base inventory.

Given the uncertainties in existing stand volumes, the impacts of decreasing existing unmanaged spruce stand yields (yield curves created through VDYP) by 21.2% were assessed. In the Prince George TSA the netting out of uneconomic stands is dependent upon the height class attributes and volumes of these stands (see Tables A-8 and A-9 in Appendix A). Because the attributes of both height and volume are altered an additional 22 700 hectares of land base is excluded from the timber harvesting land base as a result of being uneconomic. Figure 22 shows the results of incorporating the results of the inventory audit. Figure 23 shows the effect of adjusting all of the existing unmanaged stand volumes by 10%. Unlike the audit sensitivity analysis this later analysis assumes that the base case land base is unchanged.

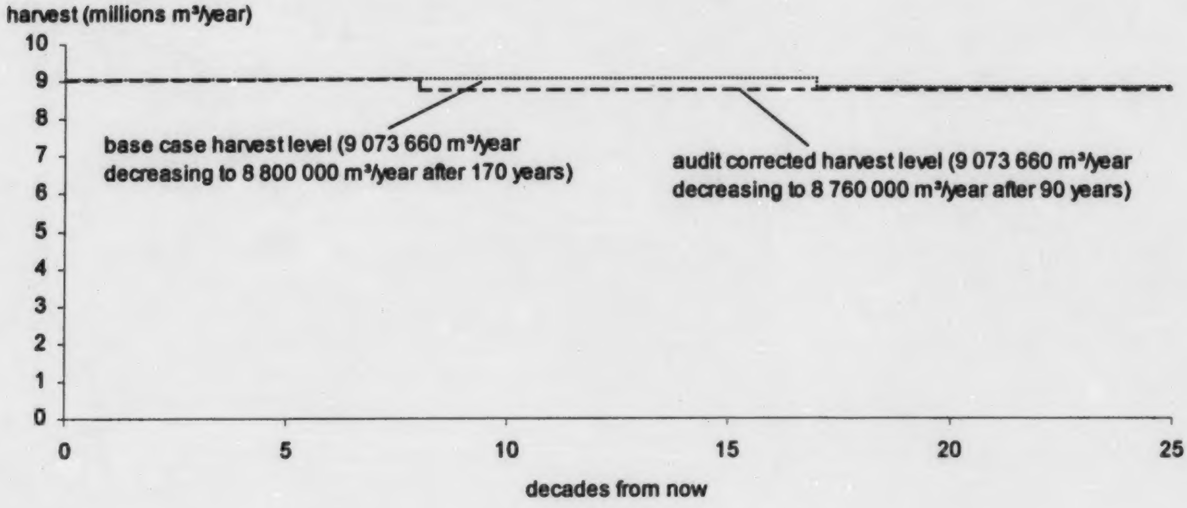


Figure 22. Harvest forecast incorporating the inventory audit results — Prince George TSA, 2001.

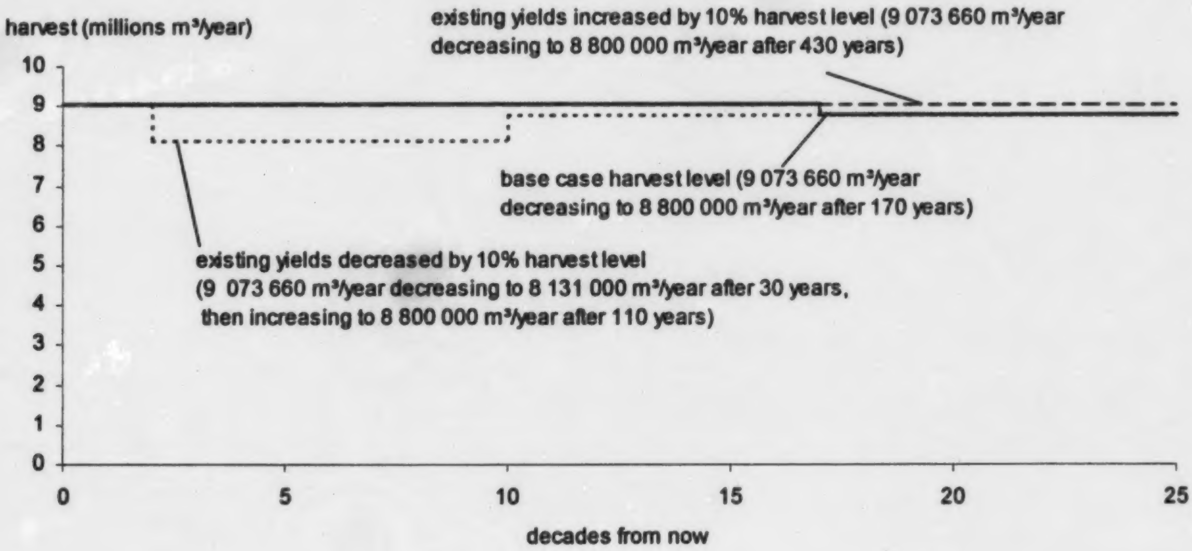


Figure 23. The effect on the harvest forecast of decreasing or increasing volume estimates for existing unmanaged stands — Prince George TSA, 2001.

Existing spruce volumes 21.2% lower than in base case (audit sensitivity)

- Initial harvest level of 9 073 661 cubic metres per year can be maintained for 80 years.
- Long-term level of 8 760 000 cubic metres per year (40 000 cubic metres per year lower than the base case, a result of decreasing the timber harvesting land base by 22 700 hectares).

Existing stand volumes 10% lower than in base case

- Initial harvest level of 9 073 661 can be maintained for 20 years.
- Mid-term harvest forecast (decades 3 to 9) is 8 131 000 cubic metres per year, 10.4% below the base case level.
- After decade 10 the harvest forecast is the same as the long-term level in the base case.

Existing stand volumes are 10% higher than in base case

- Initial harvest level of 9 073 661 cubic metres per year can be maintained for over 400 years.
- Long-term level is 3% higher than the base case long-term harvest level.

5.8 Uncertainty in the estimated managed stand yields

Uncertainty in volume estimates for managed stands exists for the same reasons listed for estimated existing stand yields (inaccuracies in the forest inventory and the growth and yield models), but also because of the limited experience and data that is available for regenerated managed stands in British Columbia. In this section, the timber supply effects of uncertainty associated with predicting volumes in regenerated stands is examined.

Figure 24 shows the harvest forecasts that result when regenerated stand volumes are decreased or increased by 10%.

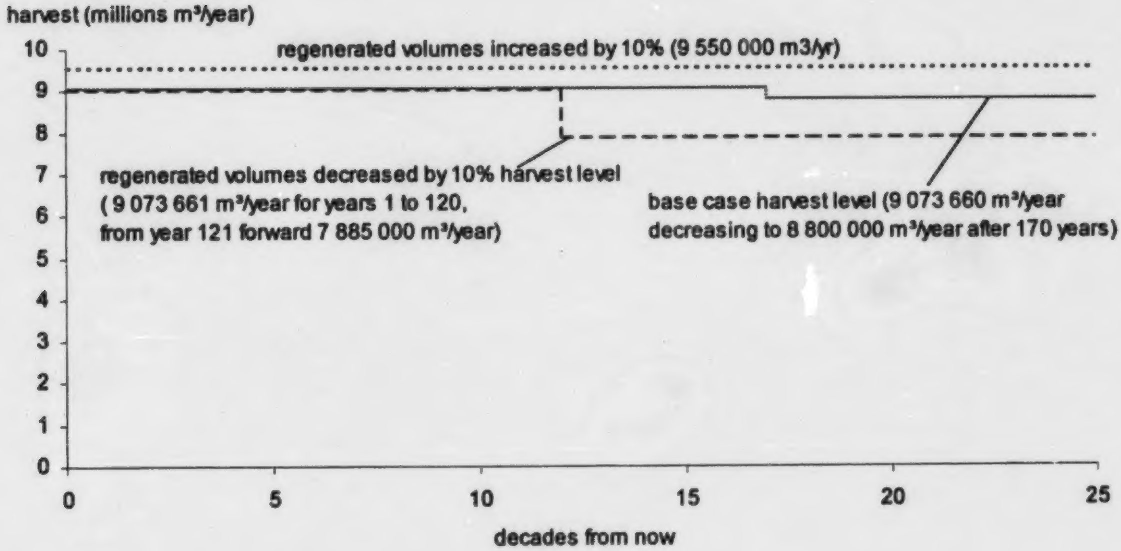


Figure 24. The effect on the harvest forecast of decreasing or increasing volume estimates for managed stands by 10%— Prince George TSA, 2001.

Managed stand yields increased by 10%

- New long-term harvest level of 9 550 000 cubic metres per year is reached immediately. This level is 5.3% higher than the initial base case harvest level and 8.5% higher than the long-term level.

Managed stand yields decreased by 10%

- The initial harvest level of 9 073 660 cubic metres per year can be maintained for 120 years.
- New long-term level is reached by year 120 at 10.4% below the base case long-term level.

Increases to managed stand yields have an effect on the short-term harvest forecast for the Prince George TSA. This is a result of the large amount of available existing mature volume. Regenerated stands are not eligible for harvest until they have reached their minimum harvestable ages, which range between 50 and 160 years. While some young existing managed stands will achieve their minimum harvestable age beginning in a few decades, the timber inventory in the TSA is dominated by older stands. The harvest is not projected to be dominated by regenerated stands until about 100 years from now (see Figure 9).

5.9 Uncertainty about management requirements in all management zones

In the Prince George TSA, about 88% of the timber harvesting land base is managed under normal integrated resource management (IRM) regimes. The management strategy for this forest is to allow a maximum of 25% in a non-green up state. Twelve per cent of the forest is governed by other management strategies such as visual quality, and caribou habitat. These strategies tend to hold timber in a mature state longer than the IRM zone and result in extended rotation periods. If these areas were also managed under normal IRM strategies more timber would be available for harvest. A sensitivity analysis was done to explore how much the harvest flow would benefit if all of the forest was managed as normal integrated resource management (IRM).

The sensitivity analysis graph is not shown but the results indicate that the initial harvest level of 9 073 661 cubic metres per year can be maintained for 170 years, similar to the base case. Starting in year 171 the long-term harvest level can be raised 200 000 to 9 000 000 cubic metres per year.

5.10 Uncertainty in minimum harvestable ages

Minimum harvestable ages (MHA) are an estimate of the time needed for stands to reach a merchantable condition. They affect the time over which existing stands must be metered-out while regenerated stands grow to merchantability. The time at which stands will become merchantable is not known with precision because of uncertainty about the growth of regenerated stands, and an inability to foresee future conditions that will determine merchantability.

For existing stand in this analysis spruce stands are considered mature and merchantable at 101 years, pine at 81 years, fir, cedar and hemlock at 111 years, alpine fir at 121 years and aspen at 61 years. Approximately 93% of the stands in the timber harvesting land base of the Prince George TSA are currently at or above the minimum harvestable age applicable to the stand. In this instance minimum harvestable ages are based on a standard operating procedure issued by the Forest Service Regional Manager.

When the minimum harvestable age was reduced by 10 years compared to the base case the harvest flow was identical to the base case.

Figure 25 shows how timber supply would change if stands become merchantable 10 and 20 years later than the base case.

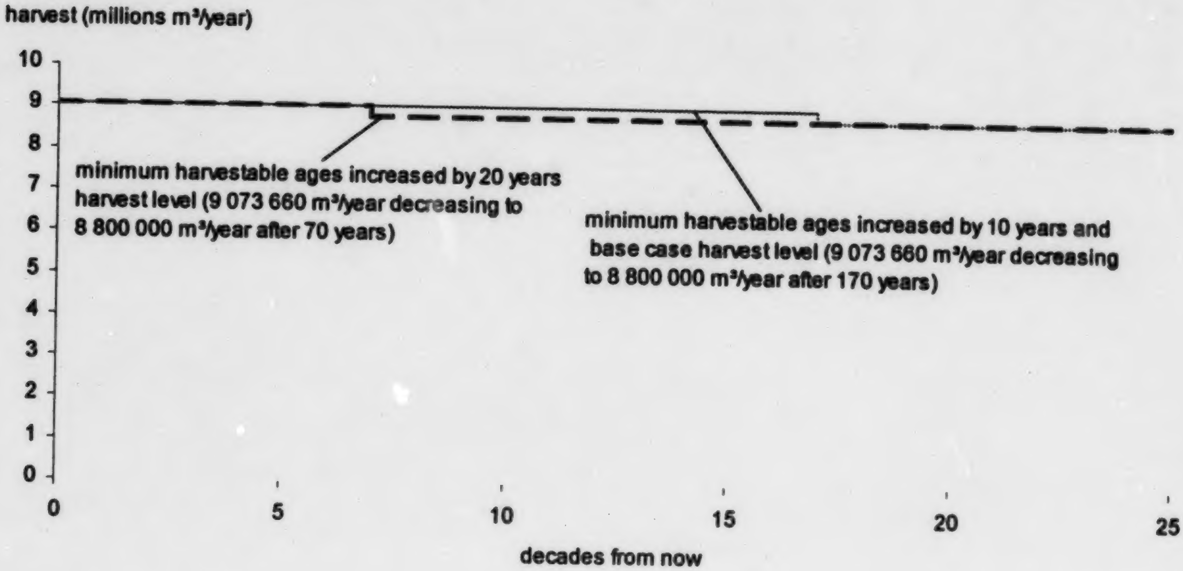


Figure 25. Harvest forecasts if minimum harvestable ages are older than those used in the base case — Prince George TSA, 2001.

Ten-year decrease in minimum harvestable ages

- No change from the base case harvest projections.

Ten-year increase in minimum harvestable ages

- No change from the base case harvest projections.

Twenty-year increase in minimum harvestable ages

- Similar to the base case except the long-term harvest level of 8 800 000 cubic metres per year is reached in decade 7 as opposed to decade 17 in the base case.

5.11 Uncertainty in green-up height

Within the Prince George TSA base case it was assumed that no more than 25% of the timber harvesting land base within each landscape unit (LU) could be less than 3 metres in height. The 25% limit approximates a 4-pass harvest system. The age when stands attain the height condition depends on the mix of species and site productivity of the landscape unit. The data models used in this analysis show that in the Prince George TSA stands reach 3 metres height in 14 to 34 years depending on the site productivity. For stands where there are visual quality concerns the green up height is 5 metres.

Some studies have shown that the time taken to achieve green-up in practice is less than the results obtained from the models used to project green-up (*Juvenile height development in interior spruce stands of British Columbia.* Nigh and Love, 2000). Both the percentage limitation and the age at which green-up is assumed to occur are sources of uncertainty.

Figure 26 shows how timber supply would change if time to achieve green-up ages (both for 3 and 5 metre green-up) were decreased or increased by 10 years.

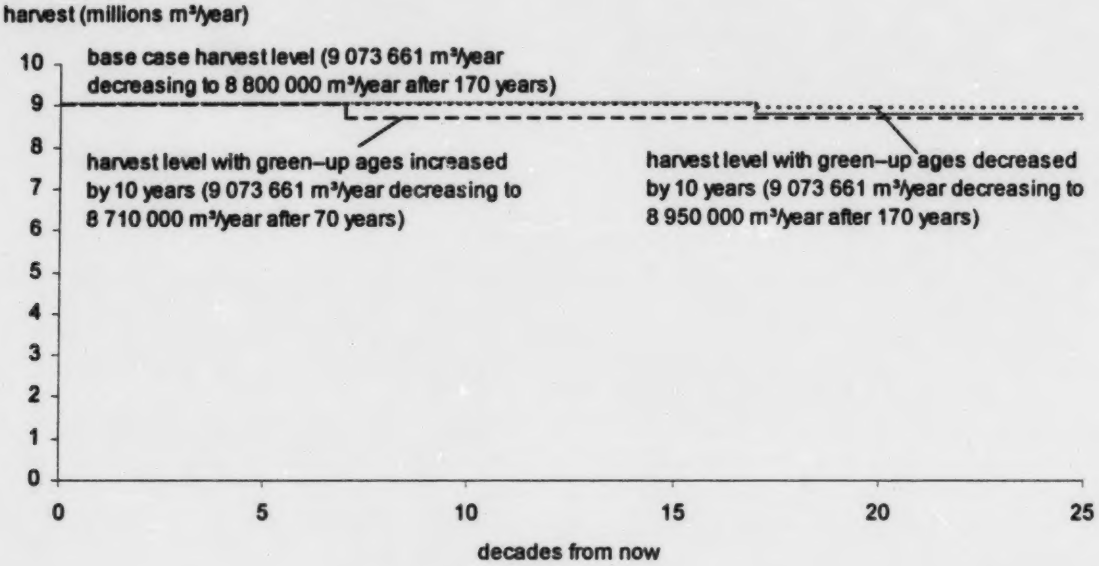


Figure 26. The effect on the harvest forecast of decreasing or increasing the length of time to achieve 3 and 5-metre green-up — Prince George TSA, 2001.

Green-up ages decreased by 10 years

- Short and mid-term harvest forecast is the same as the base case for the first 17 decades.
- The long-term harvest level increases by 150 000 (1.7%) to 8 950 000 cubic metres per year.

Green-up ages increased by 10 years

- The initial harvest level of 9 073 661 cubic metres per year can be maintained for 7 decades.
- The long-term level is 90 000 cubic metres per year below the base case long-term level of 8 800 000 cubic metres per year.

5.12 Uncertainty in site productivity

The productivity of a site largely determines how quickly trees will grow. It therefore affects the timber volumes in regenerated stands, the time to reach green-up and the age at which those stands will reach merchantable size. The most accurate estimates of site productivity come from stands between 30 and 150 years old. At ages less than about 30 years a temporary increase or decrease in growth due to factors such as a post-harvest flush of nutrients or an unusual drought year can affect the overall productivity estimated for the stand.

Old growth site index (OGSI)

Site productivity estimates derived for older stands may be incorrect because tree heights do not represent actual productivity — for example due to top breakage — and it is very difficult to determine ages of old trees accurately. The results of recent province-wide research suggest that the estimated productivity of sites currently occupied by old-growth stands may be significantly underestimated. Two Old-Growth Site Index (OGSI) studies applicable to timber supply forecasting are:

Site index adjustments for old-growth stands based on paired plots (Nussbaum 1998). Data were obtained from paired plots installed in old-growth stands and adjacent logged and regenerated stands of the same productivity. Site index was estimated for both and comparisons were made. Results are available for Douglas-fir, lodgepole pine, and interior spruce.

Site index adjustments for old-growth stands based on veteran trees (Nigh 1998). The objective of the study was to develop site index adjustments for species not covered by the paired-plot project. The data for this study came from temporary and permanent plots with a veteran and main stand component. The site indices for the two components were estimated and an adjustment equation for each species was derived using linear regression analysis. The results of the study are considered less reliable than those from the paired-plot study.

The results of these studies are of interest in the Prince George TSA since stands older than 140 years comprise 37% of the timber harvesting land base. To test the sensitivity of the base case harvest forecast to uncertainty about site productivity estimates, an analysis was performed that incorporated adjustments to site indices.

Site indices of stands older than 140 years were adjusted using either the paired-plot or veteran-tree results, whichever was applicable. Managed stand volume estimates for those analysis units (AU) affected by changes in estimated future productivity were recalculated based on average adjusted site productivity. Green-up and minimum harvestable ages were also recalculated. Table 7 compares the average forest inventory-based site index for each analysis unit to those defined using each of the adjustments.

The sensitivity analysis based on old-growth site index adjustments was done but the harvest forecast is not shown. Applying OGSI adjustments results in an even-flow harvest level of 10 256 000 cubic metres per year. This is 1 456 000 cubic metres per year (15.6%) higher than the long-term harvest flow of the base case. As was seen with the sensitivity analysis that examined the increased managed stand volumes (Section 5.8) an increase in the volume expected from future stands allows the harvest level to be increased immediately because of the large amount of existing mature volume in the TSA.

Table 7. Old growth site index (OGSI) adjustments to site index

Analysis unit	Leading species	Existing site index (SI)	Site index (SI) adjusted for OGSI	Difference between OGSI adjusted SI and base case SI
Prince George Forest District (A or 1)				
1101	Douglas-fir	17.38	17.38	0.0
1102	Cedar	14.86	14.86	0.0
1103	Hemlock	12.67	12.67	0.0
1104	Balsam fir	12.72	12.72	0.0
1105	Spruce ≥ 12	16.35	19.48	3.1
1106	Spruce < 12	9.88	19.03	9.2
1107	Pine	18.31	18.72	0.4
1108	Deciduous (aspen)	N/A	N/A	N/A
1109	High elevation S & B	11.31	11.31	0.0
Vanderhoof Forest District				
2101	Douglas-fir	16.22	16.22	0.0
2104	Balsam fir	12.31	12.31	0.0
2105	Spruce ≥ 12	15.08	17.16	2.1
2106	Spruce < 12	10.01	17.31	7.3
2107	Pine	14.95	16.48	1.5
2108	Deciduous (aspen)	N/A	N/A	N/A
2109	High elevation S & B	9.25	9.25	0.0
2117	Small pine	11.01	13.19	2.2
Fort St. James Forest District				
3101	Douglas-fir	16.92	16.92	0.0
3104	Balsam fir	11.02	11.02	0.0
3105	Spruce ≥ 12	15.99	18.49	2.5
3106	Spruce < 12	9.27	18.28	9.0
3107	Pine	17.09	17.94	0.9
3108	Deciduous (aspen)	N/A	N/A	N/A
3109	High elevation S & B	9.58	9.58	0.0

5.13 Uncertainty in application of biodiversity seral stage retention recommendations

The *Forest Practices Code Act of British Columbia (FPC)* describes the conservation of biodiversity as an essential component of sustainable forest use. The *FPC Landscape Unit Planning Guide (LUPG)* provides recommendation for maintaining biodiversity at both the stand- and landscape-levels. Stand-level biodiversity has been addressed in this analysis by a reduction in area of 3.5%. Therefore, uncertainty about stand-level biodiversity can be assessed through sensitivity analysis that examines the changes to the timber harvesting land base. Management for landscape-level biodiversity was modelled in this analysis through the use of forest cover requirements applied to each combination of natural disturbance type (NDT), biogeoclimatic subzone, and variant within each landscape unit. To establish the base case with respect to the application of landscape-level biodiversity two sensitivity analyses were tested:

1. For the first sensitivity analysis, old-growth targets, as found in the *Landscape Unit Planning Guide*, were applied at the biogeoclimatic variant level within each draft landscape unit/NDT combination. These targets were a weighted average of the lower, intermediate and higher biodiversity emphasis option (BEO) targets with 45% assumed as low, 45% as intermediate and 10% as high. In areas subject to the lower BEO, an initial drawdown of the old-seral requirements to one-third of the target was allowed. Early or mature-plus-old seral* objectives are not applied.
2. The second sensitivity analysis was very similar to the first except that NDT 3 mature-plus-old objectives are applied in addition to old-growth targets for all NDTs.

Application of the mature-plus-old for the Prince George TSA does not have any additional impact on the harvest flow and the base case incorporated seral-stage targets for mature-plus-old in NDT 3. There is uncertainty about how the recommendations in the *Landscape Unit Planning Guide* will be applied once landscape units and BEOs are declared. Currently proposed BEO emphasis in the Prince George TSA is 10% of the area as high, 48% intermediate, and 42% as low emphasis for biodiversity (current option), with areas shown in Table 8.

Several sensitivity analyses were performed to evaluate the potential timber supply impacts associated with uncertainty about landscape-level biodiversity management. The first analysis is the same as base case except that only old-seral targets must be met immediately in all landscape units — biogeoclimatic variant combinations, i.e., no drawdown of the old-forest requirement in low biodiversity emphasis landscape units. The results of this sensitivity is no change from the base case harvest flow. Following are two additional sensitivity analyses which assess first the impact of applying the proposed landscape unit BEO emphasis and second the FPC average BEO emphasis (45:45:10).

Old seral

Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.

Table 8. Landscape unit FPC proposed emphasis

Forest district	Biodiversity emphasis	Gross area (hectares)	Productive forest (hectares)	Timber harvesting land base (hectares)	Excluded forested (hectares)
Prince George	High	587 750.54	362 960.76	135 023.92	227 936.84
	Intermediate	1 650 502.44	1 155 055.24	650 277.72	504 777.52
	Low	886 201.98	683 201.13	505 113.04	178 088.09
	All	3 124 454.96	2 201 217.13	1 290 414.68	910 802.45
Vanderhoof	High	162 595.38	142 421.64	73 582.82	688 38.83
	Intermediate	555 895.35	437 391.57	333 992.79	103 398.78
	Low	666 696.5	479 633.94	376 865.65	102 768.28
	All	1 385 187.24	105 9447.15	784 441.26	275 005.89
Fort St. James	High	486 416.03	257 581.38	139 121.24	118 460.14
	Intermediate	1 402 577.09	966 531.45	611 668.02	354 863.43
	Low	1 235 531.41	806 348.53	526 515.76	279 832.77
	All	3 124 524.53	203 0461.36	1 277 305.02	753 156.34
TSA summary	High	1 236 761.95	762 963.78	347 727.98	415 235.81
	Intermediate	3 608 974.88	2 558 978.26	1 595 938.53	963 039.73
	Low	2 788 429.89	1 969 183.6	1 408 494.45	560 689.14
	All	7 634 166.72	5 291 125.64	3 352 160.96	1 938 964.68

Figure 27 shows the impact of applying the current option for BEOs, meet early, mature-plus-old and old-seral targets immediately in all landscape unit — biogeoclimatic zone variant combinations as required by the *Landscape Unit Planning Guide*. Cutblock adjacency is not applied.

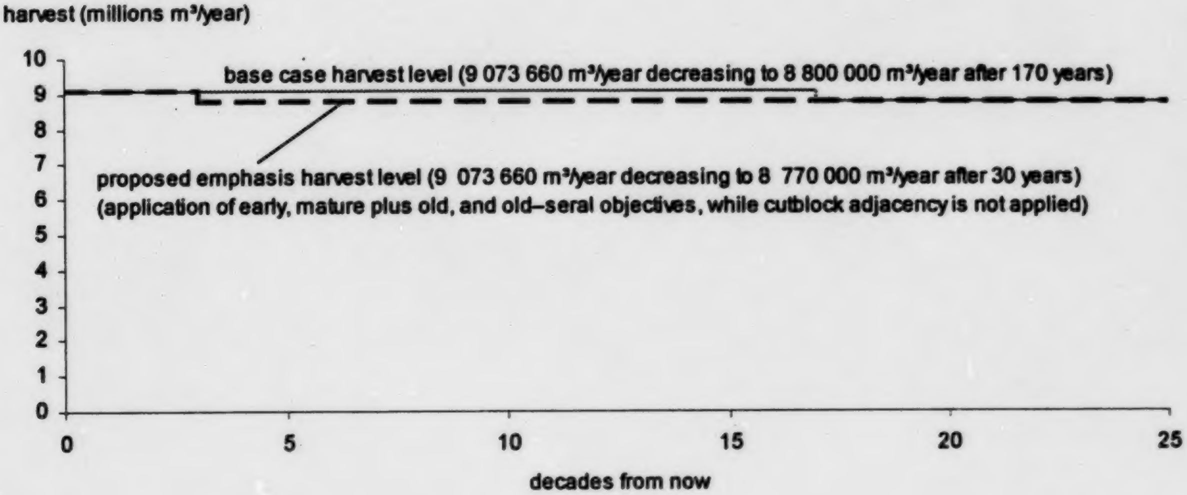


Figure 27. The effect on the harvest forecast of using the proposed BEO emphasis for each landscape unit and requiring old-seral targets to be met immediately — Prince George TSA, 2001.

Figure 28 shows the impact of applying the Forest Practices Code target of 45:45:10 averaged BEO applied to the timber harvesting land base (9 073 660 cubic metres per year decreasing to 8 170 000 cubic metres per year after 20 years).

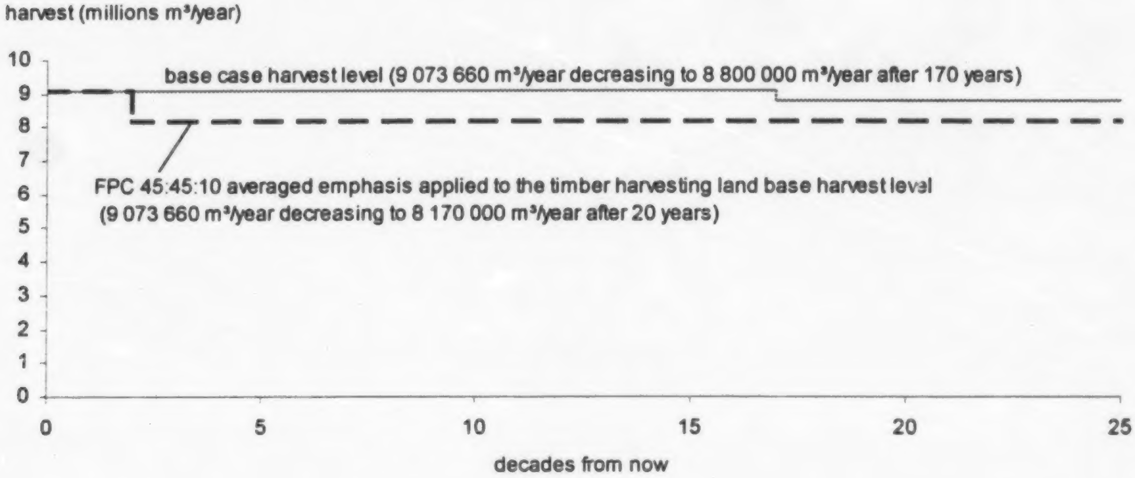


Figure 28. The effect on the harvest forecast of using the average 45:45:10 (low, intermediate and high) BEO while applying old, mature plus old, and early-seral targets to be met immediately on the timber harvesting land base — Prince George TSA, 2001.

Apply proposed landscape unit BEO emphasis and old-seral targets met immediately

- Initial harvest level of 9 073 661 cubic metres per year is maintained for 30 years
- Mid- and long-term harvest level of 8 770 000 cubic metres per year (30 000 less than the base case).

Apply 45:45:10 (low, intermediate and high) BEO and old, mature plus old, and early-seral targets to be met immediately on the timber harvesting land base

- Initial harvest level of 9 073 661 cubic metres per year is maintained for 20 years
- Mid- and long-term harvest level of 8 170 000 cubic metres per year (630 000 less than the base case).

5.14 Uncertainty in aging of forest in the non-timber harvesting land base

The base case and all the sensitivity analyses described in this report assume that the forest in the non-timber harvesting land base grows undisturbed and therefore ages throughout the planning horizon. Where there is sufficient forest in the non-timber harvesting land base, these areas will, in time, be able to provide all the old-forest requirements. As seen in Figure 5, "Current age-class composition," there is forest in the younger age classes in the non-timber harvesting land base. While it is known that there are stand-disturbing events in the non-timber harvesting land base, the rate of disturbance and the location of these events are not known well enough.

A sensitivity analysis was conducted where the non-timber harvesting land base was be "harvested" by natural events when it reaches 300 years of age. This excluded forest effectively cycles on a 300 year rotation. This rate was chosen as the upper range of the natural disturbance return interval of the ESSF biogeoclimatic subzone.

The results of this sensitivity analysis indicate no change to the harvest flow for the first 110 years. The base case initial harvest level is 9 073 661 cubic metres per year. From year 110 forward the harvest forecast drops to 8 400 000 cubic metres per year. This is 400 000 cubic metres per year (4.5%) below the base case long-term harvest level.

Table 9. Summary of sensitivity analysis — Prince George TSA, 2001

Report section	Sensitivity Analysis Description	Short term	Medium term	Long term
		Impact* (m3/yr) relative to the base case		
5.12	Include Old-growth site index adjustments	+ 1 182 000	+ 1 182 000	+ 1 456 000
5.8	Increase managed stand yields	+ 476 000	+ 476 000	+ 750 000
5.5	Include aspen stands	+ 145 000	+ 95 000	+ 95 000
5.7	Increase existing stand yields			+ 274 000
5.9	Manage all the THLB as normal IRM			+ 200 000
5.11	Reduce green-up ages			+ 150 000
5.10	Reduce minimum harvestable age 10 yrs			
5.6	Redirect harvesting to address Mtn. pine beetle epidemic			
5.10	Increase minimum harvestable age 10 yrs			
5.3	Regulate district level harvest flows			– 200 000
5.10	Increase minimum harvestable age 20 yrs		– 274 000	
5.13	Meet old seral objectives immediately & apply proposed BEO emphasis by LU		– 297 000	– 30 000
5.7	Apply inventory audit		– 314 000	– 40 000
5.11	Increase green-up ages		– 364 000	– 90 000
5.4	Exclude timber supply block A		– 584 000	– 310 000
5.13	Meet all (old, mature+old & early) seral requirements & apply against THLB		– 904 000	– 630 000
5.7	Reduce existing stand yields		– 943 000	
5.8	Reduce managed stand yields		– 1 189 000	– 915 000

* note: Impact is rounded to the nearest 1 000 m3 per year. For this analysis medium term refers to any time between 20 and 170 years from now. Please refer to the specific sections in the report for details.

6 Summary and Conclusions of the Timber Supply Analysis

The results of this timber supply analysis suggest that, given data and management assumptions that reflect current information and practices in the Prince George TSA a harvest level of 9 073 000 cubic metres per year can be maintained for 170 years. After 170 years, the projected harvest level declines 3% to a steady level of 8 800 000 cubic metres per year. The target harvest level of 9 073 661 cubic metres per year incorporates the current AAC of 9 363 661 cubic metres per year less the 390 000 cubic metres per year uplift for looper damaged cedar/hemlock stands (290 000 cubic metres per year) and woodlots (100 000 cubic metres per year), plus 100 000 cubic metres per year for cedar/hemlock salvage.

These results reflect current knowledge and information on forest inventory, growth, and management. However, uncertainty exists about several factors important in defining timber supply. A series of sensitivity analyses showed that these uncertainties could affect timber supply to varying degrees.

An analysis of alternative harvest flows indicates that an initial harvest of 12 450 000 cubic metres is achievable for the first 10 years falling at 10% per decade and achieving the long-term level of 8 800 000 cubic metres per year by decade four. This alternative harvest flow allows an additional 45 million cubic metres, over and above the base case, to be harvested over the first 30 years of the harvest forecast.

The short term (the next 20 years) is most sensitive to changes in volumes expected to be harvested from future regenerated stands. This is because of the large amount of available mature timber. When future managed stand volumes are adjusted based on old-growth site index (OGSI) studies the even-flow harvest level is 13.3% above the initial base case level. The short-term timber supply is also sensitive to the addition of stands where aspen makes up the major per cent of the trees. This land base supports a 30 year harvest level of 145 000 cubic metres per year falling at 10% to a long-term harvest level of 95 000 cubic metres per year starting 70 years from now. None of the sensitivity analyses conducted indicated a short-term harvest level lower than the base case.

The mid-term harvest level in this analysis is generally considered as the period of time between 21 and 170 years into the harvest flow projection. The largest potential effects on projected harvests over the mid term are associated with uncertainties in estimates of timber volumes in existing stands. Two inventory audits conducted over the past 5 years suggest that the inventory estimate of volumes in the operable portion only of the spruce-leading stands in the Prince George Forest District part of the TSA (approximately the timber harvesting land) may be 21.2% higher than estimates based on ground measurements. If the audit reflects the true volume, the current harvest level can maintained, but the base case timber supply will be reduced by approximately 3.5% during decades eight to seventeen.

Supply Block A is located in the remote northwest reaches of the Fort St. James Forest District part of the Prince George Timber Supply Area and is primarily undeveloped. Removing Supply Block A from the TSA showed a reduction from the base case of approximately of 6.4% for the mid term and 3.5% for the long term. If the time required to achieve green-up was increased there is a decrease in the long-term level. Decreasing green-up ages results in an increase to the harvest flow.

The long-term harvest level (after decade 17) is affected by a few factors. If all of the forest was managed as part of the normal integrated resource management (IRM) zone the long-term harvest level could be increased. If the timber supply was managed as three separate TSAs split by current forest district the mid- to long-term level would be reduced.

6 Summary and Conclusions of the Timber Supply Analysis

The central interior of British Columbia is experiencing one of the worst mountain pine beetle outbreaks in recent history. A sensitivity analysis showed that 80% of the TSA harvest could be re-directed in to mature pine stands for the next 20 years with no detrimental effects on the base case harvest flow.

In conclusion, this analysis indicates that based on current inventory, growth and yield, and forest management information, timber harvests in the Prince George TSA can be maintained at 9 073 661 cubic metres per year for 170 years. Due to the age class distribution and the large volume of available timber, few areas of uncertainty examined in the analysis indicate significant risk to projected timber supply. However, except for the likelihood that existing spruce stand volume in the Prince George Forest District may be overestimated, and site indices for old-growth stands may be underestimated, there is no conclusive evidence to suggest that significant inaccuracies exist in the information used in this analysis.

7 Socio-Economic Analysis

The impact of timber supply adjustments on local communities and the provincial economy is an important consideration in the Timber Supply Review. The socio-economic analysis compares the level of forestry activity currently supported by timber harvested from the Prince George TSA to the level of activity that the TSA could support as the timber supply moves towards its long-term harvest level.

The socio-economic analysis examines harvest levels as projected in the base case harvest forecast and is not intended to examine alternative management scenarios.

The socio-economic analysis consists of the following:

- a profile of the current socio-economic setting;
- a description of the Prince George TSA forest industry; and
- an analysis of the socio-economic implications of the base case harvest forecast.

7.1 Current socio-economic setting

7.1.1 Current population and demographic trends

The Prince George TSA is comprised of three forest districts: Prince George, Vanderhoof and Fort St. James. Each district is administered by its own Forest Service office.

In 2000, the population of the Prince George TSA was approximately 109 000 people.[1] From 1996 to 2000, the population of the TSA increased by an estimated 3%. The largest community in the Prince George TSA is the City of Prince George with an estimated 2000 population of 81 326 people. Other larger communities located in the TSA include Vanderhoof, Fort St. James and Fraser Lake. Numerous other smaller communities are located throughout the TSA. From 2000 to 2005, the population of the TSA is expected to increase by an estimated 6.2%; this is below the expected average provincial population growth rate of 7.6%. Table 10 shows the population levels for the Prince George TSA, forest districts and communities where data are available.

There are distinct differences between the three forest districts that comprise the Prince George TSA. Prince George District has 84% of the total population of the TSA, of which 88% live in the City of Prince George. Vanderhoof District has 11% of the population, of which 50% live in the communities of Vanderhoof and Fraser Lake. Fort St. James District has 5% of the population, of which 44% live in the district's largest community, Fort St. James. Communities within the three districts have different rates of growth. In Fort St. James and Fraser Lake, populations have either grown very little or declined; whereas, in Vanderhoof and Prince George rates of growth have been higher, although lower than the provincial average.

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(1) The TSA estimate was calculated using British Columbia Stats population estimates for each community and a community/district ratio.

Table 10. Prince George TSA and selected community population statistics, 1991–2000

	1991	1996	2000[a]	2005[b]	% change 1996–2000
Prince George	69,653	78,396	81,326	N/A	3.7
Vanderhoof	4,023	4,589	4,830	N/A	5.2
Fort St. James	2,058	2,136	2,130	N/A	– 0.2
Fraser Lake	1,302	1,403	1,328	N/A	– 5.3
Prince George Forest District	81,592	89,198	92,245	98,000	3.4
Vanderhoof Forest District	10,747	11,658	12,175	12,900	4.4
Fort St. James Forest District	4,496	4,906	4,865	5,200	– 0.8
Prince George TSA	96,835	105,762	109,285	116,100	3.3
British Columbia	3,282,910	3,882,043	4,063,760	4,372,208	4.7

Source: Census of Canada 1991, 1996. British Columbia Stats Population Statistics.

(a) Population estimates from British Columbia Stats; estimate for Prince George TSA based on 82% share of larger communities.

(b) Prince George TSA estimate based on a weighted average 2000-2005 growth rate of 6.2% for the Nechako and Prince George local health areas. Population projections for local health areas from British Columbia Stats. 2005 forest district projections based on individual forest district share of TSA population.

N/A = not available.

7.1.2 Economic profile

From 1991 to 1996, the total experienced labour force in the Prince George TSA increased by 13% to 58,540 from 51,855.[2] In comparison, the provincial experienced labour force increased by 14% over the same period. The unemployment rate in the Prince George TSA was 12% in 1996 compared with 14% in 1991. Since 1996, unemployment data for the Cariboo and North Coast/Nechako development regions, which encompass the Prince George TSA, indicate that these unemployment rates have likely increased.[3]

These TSA-level statistics mask somewhat the experience of each forest district. The Prince George Forest District, which contained 85% of the experienced labour force in 1996, had a 12% increase in its labour force from 1991 to 1996. In contrast, the Vanderhoof Forest District grew by 28% and the Fort St. James Forest District increased by 14%. Since 1996, given the increasing population of the TSA, the labour force has likely also grown, mostly in the Prince George and Vanderhoof areas.

The unemployment rate for each district also varied. The Fort St. James Forest District had an unemployment rate of 16% in 1996; the Vanderhoof Forest District had an unemployment rate of 14%; and the Prince George Forest District had an unemployment rate of 11%.

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(2) Census of Canada, 1991, 1996.

(3) British Columbia Stats. Web site www.bcstats2.gov.bc.ca. Data based on Statistics Canada, Labour Force Survey.

Figures 29, 30, and 31 show experienced labour force by sector for the three forest districts. The percentages are based on total, direct, indirect and induced employment. Until data from the 2001 Census of Canada are available, post-1996 employment estimates for most sub-provincial regions will not be available. Where data are available, some discussion of post-1996 employment changes is presented.

In each of the forest districts, the forest sector, comprised of logging, forestry services and forest products manufacturing, supports the most employment, although Prince George's more diversified economy is evident. In Vanderhoof and Fort St. James, the forest sector accounts for 41% and 54% of total employment, respectively, while in Prince George it accounts for approximately 30%. In terms of income, the forest sector is the source of 29% of the income within the Prince George Forest District, and 43% and 57% of the income in the Vanderhoof and Fort St. James forest districts, respectively. There are also differences within individual forest districts that can also be highlighted. For example, in the Vanderhoof Forest District, forestry, agriculture and the public service are the predominate sectors around the community of Vanderhoof. However, Fraser Lake, located to the east of Vanderhoof, relies on forestry and mining for as much as 75% of it total employment.

From 1990 to 1996, employment in the logging and forestry services sub-sector increased steadily in Vanderhoof and Fort St. James forest districts by approximately 26% and 43%, respectively. Over the same period, in the Prince George Forest District, the logging and forestry services sub-sector increased by just over 2%. Forest products manufacturing fluctuated through the early 1990s, but reached its highest level in 1996 at approximately 5,650 employees.

Since 1996, labour force data for the Cariboo and North Coast/Nechako development regions indicate that employment in logging and forestry services has increased in the development regions, although the low harvest rates in 1997 and 1998 suggest that logging-related employment would have declined during that two-year period. Since 1996, forest products manufacturing data for the three forest districts indicate that employment in this sub-sector decreased by close to 12% across the Prince George TSA, with the largest reductions in the Fort St. James and Prince George forest districts.[4]

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(4) Ministry of Forests, Economics and Trade Branch..

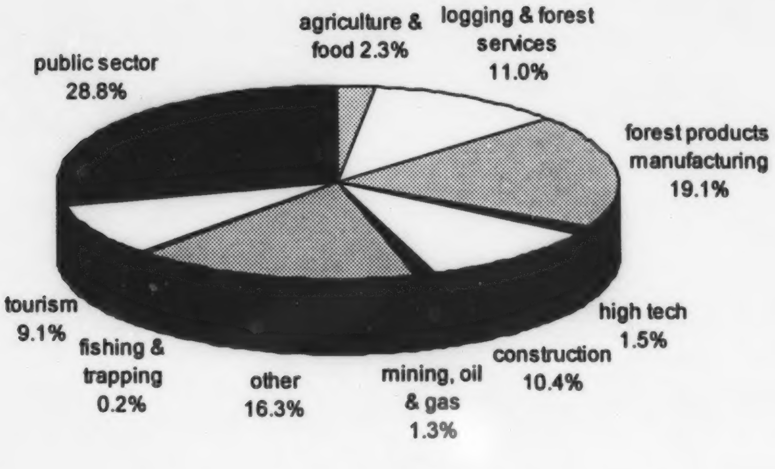

Figure 29. Prince George Forest District experienced labour force by sector, 1996.

Source: British Columbia Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables. Victoria, British Columbia.

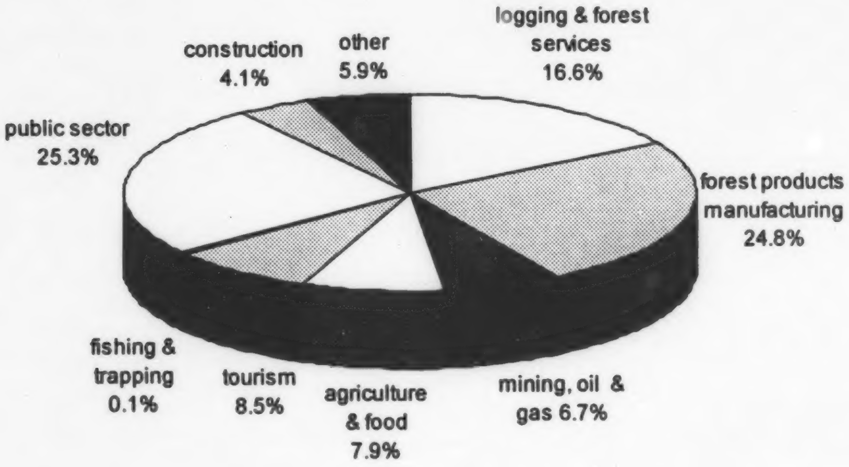

Figure 30. Vanderhoof Forest District experienced labour force by sector, 1996.

Source: British Columbia. Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables. Victoria, British Columbia.

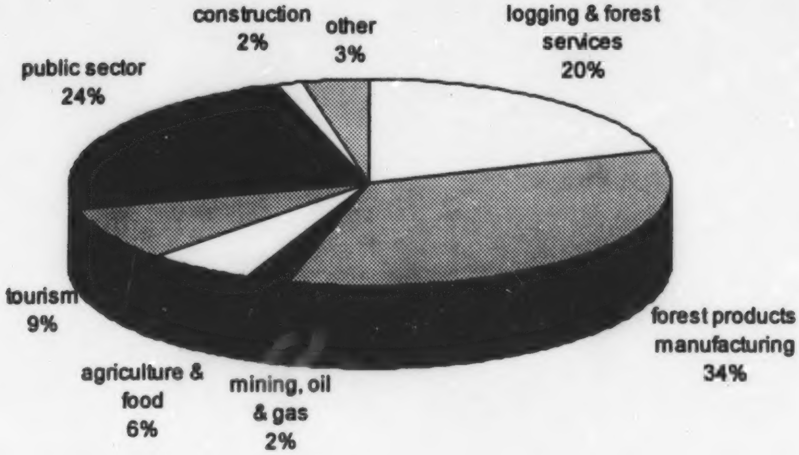

Figure 31. Fort St. James Forest District experienced labour force by sector, 1996.

Source: British Columbia Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables. Victoria, British Columbia.

The public sector is the second largest employer in the Prince George, Vanderhoof and Fort St. James Forest Districts accounting for 29%, 25% and 24% of total employment, respectively. The public sector includes municipal, provincial and federal employees, and education and healthcare workers. The level of employment supported by public expenditures in the Prince George Forest District is average when compared with public sector employment in other forest districts, but both the Vanderhoof and Fort St. James districts are slightly below the provincial average. The total income supported by public sector activity in the Prince George, Vanderhoof and Fort St. James Forest Districts was 25%, 20% and 19%, respectively. From 1991 to 1996, public sector employment increased by 16% in the Prince George Forest District, 13% in the Vanderhoof Forest District and 18% in the Fort St. James Forest District.

Employment in the travel sector, which includes business and tourism travel, employs about 9% of the total labour force in each of the forest districts. The income supported by the travel sector accounts for about 4% of the total income within the forest districts. The difference between the employment and income percentages reflects the lower than average incomes paid to travel and tourism service sector workers in general, and the lower company expenditures on supplies and services. From 1991 to 1996, accommodation, which is a component of the travel sector, increased in the Prince George, Vanderhoof and Fort St. James Forest Districts by 11%, 7% and 28%, respectively.

Agriculture and food is another important sector, especially in the Vanderhoof Forest District where it supports about 8% of the total employment. Agriculture is also important in the Prince George Forest District; while it employs a smaller percentage of the labour force, agriculture supports over twice as many people in the Prince George Forest District compared with the Vanderhoof Forest District (863 direct jobs in Prince George *versus* 400 direct jobs in Vanderhoof). Many of these jobs are part time and incomes are supplemented in other sectors such as forestry. Agriculture in both forest districts is comprised mainly of livestock- and feed-related activities.

At first glance mining does not appear to be a significant sector within the Prince George TSA, but for the Vanderhoof Forest District and the community of Fraser Lake in particular, mining is equal in importance to forestry. The Endako molybdenum mine has been in production since 1965, with a temporary closure from 1982 to 1986. It is currently owned by Thompson Creek Mining of Colorado and Nissho Iwai Corp. of Japan. According to the 1996 Census, 175 Fraser Lake residents were directly employed in mining and the mine itself employed an average of 228 people (some employees reside outside of Fraser Lake). At the end of 1998, production at the Endako mine was reduced and about 40 employees were laid off. Other mining activity in the Prince George TSA consists of rock or limestone quarries, small placer gold mining and exploration activity.

In the TSA overall, employment in the construction sector also increased between 1991 and 1996; however, there are important differences between districts. The construction sector, while shrinking by 16% in the Vanderhoof Forest District from 1991 to 1996, increased by 12% in the Prince George Forest District and by 63% in the Fort St. James Forest District. Construction is highly variable; however, and often reflects capital construction projects that are short-lived. As a result, these growth rates may not be useful indicators of trends since 1996.

Employment multiplier

An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

The sectors previously discussed include supply and service industries. In the following discussion, the supply and service components are separated into individual categories. From 1991 to 1996, supply and service business activity increased in the Prince George, Vanderhoof and Fort St. James Forest Districts by 10%, 8% and 24%, respectively.[5] Further analysis of the sector reveals differences in rates of growth for individual districts. For example, in Fort St. James, finance, insurance and real estate-related employment increased by 80% from 1991 to 1996; however, employment in transportation, communications and utilities decreased by 8%. Conversely, in Vanderhoof, finance, insurance and real estate-related employment decreased by 11%, but employment in transportation, communications and utilities increased by 19%. In the Prince George Forest District, the only supply and service sub-sector to show a decline was transportation, communications and utilities, where employment declined by 12%. Other service sectors showing strong employment growth throughout the TSA were the public sector, which grew on average by 15.8% from 1991 to 1996, and the accommodation sector, which grew by an average of 11.7%. As stated earlier, more up-to-date employment information by community and sector will not be available until the dissemination of 2001 census data.

The indirect and induced employment data included in Figures 29, 30, and 31 reflect the income spent by direct companies and employees and the number of jobs that depend on those expenditures. Employment multipliers illustrate this spending effect: a larger multiplier indicates that each job of a particular sector is associated with more business activity at supply and service companies, due to higher company revenues, supply requirements and wages. For example, multiplier estimates[6] indicate that every 100 full-time direct forestry jobs in the Prince George TSA support an additional 28 to 117 indirect and induced jobs*, depending on the forestry activity (harvesting or processing) and the forest district. In comparison, every 100 full-time direct jobs in the tourism and business travel sector support an estimated 13 to 23 indirect and induced jobs, and every 100 jobs in the public sector support an additional 23 to 40 indirect and induced jobs. Higher multipliers are due to direct companies having higher income levels spending patterns, and through higher wages and salaries. The multipliers indicate how a change to a particular sector could affect the broader economy. Table 11 compares employment multipliers for sectors of the Prince George TSA's economy.

Indirect and induced jobs
Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

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(5) Census of Canada, 1991, 1996.

(6) British Columbia Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables. Victoria, British Columbia.

Table 11. Sectoral comparison of employment multipliers — Prince George TSA, 1996

Basic sector	Prince George	Vanderhoof	Fort St. James
Forestry, logging and manufacturing	1.65-2.17	1.34-1.45	1.28-1.36
Agriculture and food	1.32	1.23	1.16
Travel (includes business and tourism travel)	1.23	1.14	1.13
Mining	1.90	1.62	1.38
Public sector	1.40	1.23	1.23
Construction	1.65	1.43	1.35

Source: British Columbia Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables. Victoria, British Columbia. Ratios shown are migration multipliers.

7.2 Prince George TSA forest industry

7.2.1 Current allowable annual cut

The current allowable annual cut (AAC), effective February, 1996, for the Prince George TSA is 9 363 661 cubic metres, which includes 290 000 cubic metres from hemlock/cedar stands. Table 12 provides a breakdown of the AAC by tenure type. Prior to the current level, the AAC was 9 073 661 cubic metres.

Table 12. Prince George TSA allowable annual cut, by licence type, 1997

	AAC (m^3)	% of total AAC
Forest licences — replaceable	6 496 774	69.4
Timber Sale Licence (TSL) < = 10 000 m^3	5 859	< 1.0
Small Business Forest Enterprise Program (SBFEP)	1 627 273	17.4
Forest Service Reserve	110 421	1.2
Woodlot licences	100 000	1.1
Forest licences, non-replaceable	733 334	7.8
Forest licences, non-replaceable hemlock/cedar	290 000	3.1
Total	9 363 661	100.0

Source: Ministry of Forests.

7.2.2 Prince George TSA harvest history

Table 13 summarizes the volume of timber harvested in the Prince George TSA from 1993 to 2000. The actual volume of timber harvested is an important indicator of forestry activity in the TSA. While the AAC is the maximum allowable annual harvest level, the actual volume of timber harvested in a particular year determines the level of economic activity. Differences in annual harvest levels are the result of cut control[7] provisions that allow licensees to vary their harvests based on operating and market conditions. If actual annual harvest levels are consistently less than the AAC, then forestry activity is below its full potential.[8]

In 2000, slightly over 9.0 million cubic metres were harvested from the Prince George TSA (see Table 13). From 1998 to 2000, the Prince George TSA harvest was spread among the Fort St. James, Prince George, and Vanderhoof Forest Districts by 30%, 49% and 21%, respectively. A recent operating area reallocation process is expected to change these percentages soon.

Table 13. Prince George TSA volumes billed, by licence type, 1993–2000

Tenure	1993	1994	1995	1996	1997	1998	1999	2000
	(cubic metres)							
Forest Licence (FL)	7 616 062	7 612 572	7 170 955	8 212 906	6 429 199	6 485 455	7 992 662	7 135 054
Small Business Forest Enterprise Program (SBFEP)	1 476 299	1 257 848	1 163 559	1 099 491	1 479 039	1 485 786	1 424 859	1 542 603
Timber Sale Licence (TSL)	12 432	5 411	15 636	1 353	524	0	9 690	627
Other[a]	408 146	439 455	401 195	470 372	521 713	397 734	346 589	327 690
Total	9 512 939	9 315 286	8 751 345	9 784 122	8 430 475	8 368 975	9 773 800	9 005 974
AAC[b]	9 073 661	9 073 661	9 073 661	9 363 661	9 363 661	9 363 661	9 363 661	9 363 661

Average harvest, cut control period 1993–1997: 9 158 834 m^3

Average harvest, 1998–2000: 9 049 583 m^3

(a) "Other" consists of cutting permits such as rights-of-way, road permits, and other small temporary permits.

(b) The AAC was increased in February 1996.

Source: Ministry of Forests.

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(7) Cut control allows licensees to vary the volume between annual harvest and AAC by ± 50% per year, and by ± 10% over a five-year cut control period.

(8) Full potential referred to here is based on the allocated volumes of the AAC, and is not necessarily the same as full economic potential which is based on the international market for wood products.

7.2.3 Prince George TSA major licensees and processing facilities

Apollo Forest Products Limited

Apollo Forest Products Limited (Apollo) has a replaceable forest licence in the Prince George TSA to harvest 220 932 cubic metres of timber per year. From 1997 to 1999, Apollo harvested all of its timber from the Fort St. James Forest District. Table 14 outlines Apollo's recent harvest activity and average employment levels in person-years* of employment associated with its Prince George TSA operations.

Table 14. Apollo volumes billed and provincial employment statistics

Allowable annual cut (AAC)	220 932 cubic metres
2000 harvest[a]	200 031 cubic metres
1997–1999 average volumes billed	227 093 cubic metres
Employment[b] (1996-1998 person-years)	
Harvesting and administration	27
Basic silviculture	15
Processing	66
Total	108

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996-1998 average volume of 196 780 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

Apollo operates a lumber mill in Fort St. James with an annual capacity to produce just over 100 million board feet of lumber products. About 97% of the timber processed at the Fort St. James mill comes from Apollo's own licence and the SBFEP. The mill employs 120 people and operates for most of the year.

Person-year(s)
One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.

7 Socio-Economic Analysis

Canadian Forest Products Limited

Canadian Forest Products Limited (Canfor) has three replaceable forest licences in the Prince George TSA to harvest a total of 3 878 273 cubic metres of timber per year and one non-replaceable forest licence to harvest 180 478 cubic metres. From 1997 to 1999, the Canfor group harvested 61% of its timber from the Prince George Forest District, 35% from the Fort St. James Forest District and the remaining 4% from the Vanderhoof Forest District. Table 15 outlines Canfor's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 15. Canfor volumes billed and provincial employment statistics

Allowable annual cut (AAC)[a]	4 058 778 cubic metres
2000 harvest[b]	4 088 035 cubic metres
1997–1999 average volumes billed	4 115 159 cubic metres
Employment[c] (1996-1998 person-years)	
Harvesting and administration	865
Silviculture	330
Processing	2,100
Total	3,295

(a) Canfor's AAC was reduced by 23 685 cubic metres as a result of its acquisition of Northwood Pulp and Timber Ltd.

(b) Harvest volumes billed include cutting permits.

(c) The employment figures relate to the 1996-1998 average volume of 4 083 364 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

Currently, Canfor's Prince George TSA operations consist of seven lumber mills, a chip mill, a veneer-plywood plant, three pulp mills and a paper mill. The lumber mill in Fort St. James is the only Prince George TSA mill operated by Canfor that is located outside the Prince George Forest District. Three of the sawmills in Prince George were acquired through Canfor's purchase of Northwood Pulp and Timber Ltd. in 1999.

In 1999, Canfor's Prince George TSA solid wood mills processed about 5.3 million cubic metres of timber in the production of close to 1,590 billion board feet of lumber products. Also in 1999, Canfor's northern pulp and paper operations had total shipments of 549 000 tonnes of pulp and 103 000 tonnes of specialty kraft paper. These operations supported slightly over 2,000 direct employees. Canfor's Prince George TSA average timber harvest of 4.1 million cubic metres represents about 80% of its mills' requirements. A further 9% comes from Tree Farm Licences (TFL) within Prince George and Fort St. James Forest Districts, and 2% comes from outside the TSA, predominantly the Cariboo Forest Region (60% of non-TSA sources).

Carrier Lumber Limited

Carrier Lumber Limited (Carrier) has a replaceable forest licence in the Prince George TSA to harvest 266 284 cubic metres of timber per year. From 1997 to 1999, Carrier harvested 94% of its timber from the Prince George Forest District, with the rest coming from Fort St. James Forest District. Carrier operates a lumber mill in Prince George. Table 16 outlines Carrier's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 16. Carrier Lumber volumes billed and provincial employment statistics

Allowable annual cut (AAC)	266 284 cubic metres
2000 harvest[a]	285 177 cubic metres
1997–1999 average volumes billed	250 015 cubic metres
Employment[b] (1996-1998 person-years)	
Harvesting and administration	45
Silviculture	20
Processing	130
Total	195

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996–1998 average volume of 215 076 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

L. & M. Lumber Limited

L. & M. Lumber Limited (L. & M. Lumber) has a replaceable forest licence in the Prince George TSA to harvest 49 514 cubic metres of timber per year. L. & M. Lumber also has a non-replaceable forest licence to harvest 250 000 cubic metres of timber per year. From 1997 to 1999, L. & M. Lumber harvested 99% of its timber from the Vanderhoof Forest District, with the rest coming from the Fort St. James Forest District. Table 17 outlines L. & M. Lumber's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 17. L. & M. Lumber volumes billed and provincial employment statistics

Allowable annual cut (AAC)		299 514 cubic metres
2000 harvest[a]		360 495 cubic metres
1997–1999 average volumes billed		316 726 cubic metres
Employment[b] (1996-1998 person-years)		
Harvesting and administration	110	
Silviculture	25	
Processing	65	
Total	200	

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996-1998 average volume of 287 655 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

L. & M. Lumber operates a lumber mill in Vanderhoof and from 1997 to 1999 processed an average of about 565 000 cubic metres of timber per year in the production of 144 to 149 million board feet of lumber. The mill operated at or near capacity during the three-year period and on average employed about 125 employees. L. & M. Lumber obtains about 70% of its timber requirements from the Prince George TSA.

Lakeland Mills Limited

Lakeland Mills Limited (Lakeland) has a replaceable forest licence in the Prince George TSA to harvest 262 284 cubic metres of timber per year. From 1997 to 1999, Lakeland harvested 92% of its timber from the Prince George Forest District and 5% from the Fort St. James Forest District. Table 18 outlines Lakeland's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 18. Lakeland volumes billed and provincial employment statistics

Allowable annual cut (AAC)	262 284 cubic metres
2000 harvest[a]	314 807 cubic metres
1997–1999 average volumes billed	273 224 cubic metres
Employment[b] (1996-1998 person-years)	
Harvesting and administration	57
Silviculture	20
Processing	120
Total	197

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996-1998 average volume of 291 264 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

Lakeland operates a lumber mill in Prince George and from 1997 to 1999 processed an average of 375 000 cubic metres of timber per year in the production of about 115 million board feet of lumber. The mill operated slightly below capacity during the three-year period and on average employs about 175-180 employees. Lakeland obtains most of its timber requirements from the Prince George TSA.

7 Socio-Economic Analysis

Plateau Forest Products Limited

Plateau Forest Products Limited (Plateau) has a replaceable forest licence in the Prince George TSA to harvest 619 223 cubic metres of timber per year. Plateau is 100% owned by Slocan Forest Products Ltd. (Slocan). From 1997 to 1999, Plateau harvested 97% of its timber from the Vanderhoof Forest District with the rest coming from the Fort St. James Forest District. Table 19 outlines Plateau's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 19. Plateau volumes billed and provincial employment statistics

Allowable annual cut (AAC)	619 223 cubic metres
2000 harvest[a]	682 086 cubic metres
1997–1999 average volumes billed	653 332 cubic metres
Employment[b] (1996-1998 person-years)	
Harvesting and administration	82
Silviculture	50
Processing	150
Total	282

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996-1998 average volume of 625 341 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

The Plateau forest licence supplies Slocan's lumber mill located in Vanderhoof. From 1997 to 1999, the Slocan mill processed an average of 1.1 million cubic metres of timber per year in the production of approximately 300 million board feet of lumber per year. About 99% of the mill's timber supply comes from its Prince George TSA forest licence and the SBFEP. The mill has operated at or slightly below capacity in recent years and on average employs about 265 people.

Stella-Jones Incorporated

Stella-Jones Incorporated (Stella-Jones) has a replaceable forest licence in the Prince George TSA to harvest 47 048 cubic metres of timber per year. From 1997 to 1999, Stella-Jones harvested 61% of its timber from the Prince George Forest District and the remaining 39% from the Vanderhoof Forest District.

Stella-Jones operates a pole mill in Prince George and trades its cut timber for appropriate log types. Table 20 outlines Stella-Jones's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 20. Stella-Jones volumes billed and provincial employment statistics

Allowable annual cut (AAC)	47 048 cubic metres
2000 harvest[a]	2 401 cubic metres
1997–1999 average volumes billed	18 101 cubic metres
Employment[b] (1996-1998 person-years)	
Harvesting and administration	9
Silviculture	2
Processing	30
Total	41

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996-1998 average volume of 42 775 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

Stuart Lake Lumber Company Limited

Stuart Lake Lumber Company Limited (Stuart Lake Lumber) has a replaceable forest licence in the Prince George TSA to harvest 202 473 cubic metres of timber per year. From 1997 to 1999, Stuart Lake Lumber harvested 100% of its timber from the Fort St. James Forest District. Table 21 outlines Stuart Lake Lumber's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 21. Stuart Lake Lumber volumes billed and provincial employment statistics

Allowable annual cut (AAC)	202 473 cubic metres
2000 harvest[a]	220 832 cubic metres
1997–1999 average volumes billed	185 583 cubic metres
Employment[b] (1996-1998 person-years)	
Harvesting and administration	28
Silviculture	15
Processing	112
Total	155

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996-1998 average volume of 187 592 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

Stuart Lake Lumber operates a lumber mill in Fort St. James. From 1997 to 1999, the mill processed an average of about 215 000 cubic metres of timber per year in the production of 50 million board feet of lumber. Stuart Lake Lumber's Fort St. James lumber mill obtains over 95% of its timber requirement from the Prince George TSA. The mill employs between 100 and 160 full- and part-time personnel.

The Pas Lumber Company Limited

The Pas Lumber Company Limited (The Pas Lumber) has a replaceable forest licence in the Prince George TSA to harvest 581 926 cubic metres of timber per year. From 1997 to 1999, The Pas Lumber harvested 95% of its timber from the Prince George Forest District and the rest from the Fort St. James Forest District. The Pas Lumber operates a lumber mill at Bear Lake. Table 22 outlines The Pas Lumber's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 22. The Pas Lumber volumes billed and provincial employment statistics

Allowable annual cut (AAC)	581 926 cubic metres
2000 harvest[a]	518 857 cubic metres
1997–1999 average volumes billed	612 052 cubic metres
Employment[b] (1996-1998 person-years)	
Harvesting and administration	115
Silviculture	50
Processing	155
Total	320

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996-1998 average volume of 571 081 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

Weldwood of Canada Limited

Weldwood of Canada Limited (Weldwood) has a replaceable forest licence in the Prince George TSA to harvest 20 320 cubic metres of timber per year. From 1997 to 1999, Weldwood harvested 93% of its timber from the Prince George Forest District with the rest coming from the Fort St. James Forest District. Table 23 outlines Weldwood's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 23. Weldwood volumes billed and provincial employment statistics

Allowable annual cut (AAC)	20 320 cubic metres
2000 harvest[a]	9 329 cubic metres
1997–1999 average volumes billed	24 820 cubic metres
Employment[b] (1996-1998 person-years)	
Harvesting and administration	5
Silviculture	2
Processing	13
Total	20

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996-1998 average volume of 21 758 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

Weldwood has no production facilities in the Prince George TSA, but has a major milling presence in the Cariboo Forest Region. Weldwood operates lumber mills in Quesnel and 100 Mile House, a pulp mill in Quesnel and veneer/plywood plants in Quesnel and Williams Lake. From 1997 to 1999, Weldwood processed an average of approximately 1.9 million cubic metres of timber per year and employed an average of 1,680 people in its mills. Timber harvested from the Prince George TSA makes up a small proportion of its overall timber supply.

West Fraser Mills Limited

West Fraser Mills Limited (West Fraser) has a replaceable forest licence in the Prince George TSA to harvest 260 908 cubic metres of timber per year. From 1997 to 1999, West Fraser harvested 95% of its timber from the Vanderhoof Forest District with the rest coming from the Fort St. James Forest District. Table 24 outlines West Fraser's recent harvest activity and average employment levels in person-years of employment associated with its Prince George TSA operations.

Table 24. West Fraser volumes billed and provincial employment statistics

Allowable annual cut (AAC)		260 908 cubic metres
2000 harvest[a]		245 786 cubic metres
1997–1999 average volumes billed		277 293 cubic metres
Employment[b] (1996-1998 person-years)		
Harvesting and administration	116	
Silviculture	22	
Processing	80	
Total	218	

(a) Harvest volumes billed include cutting permits.

(b) The employment figures relate to the 1996-1998 average volume of 238 786 cubic metres harvested from the Prince George TSA only and processed in British Columbia.

West Fraser operates a lumber mill at Lejac, near Fraser Lake. From 1997 to 1999, the Lejac sawmill processed an average of about 775 000 cubic metres of timber per year in the production of over 220 million board feet of lumber. The mill employs an average of 250 people per year. West Fraser obtains approximately 34% of its Lejac timber requirement from the Prince George TSA. Over half of the mill's timber supply comes from the Prince Rupert Forest Region.

Other licensees

The remainder of the Prince George TSA timber supply is apportioned to other non-replaceable forest licences, timber sale licences and the SBFEP.

Takla Track and Timber Limited and Takla Development Corporation have non-replaceable forest licences to harvest 200 000 cubic metres of timber and 80 000 cubic metres per year, respectively. In 2000, Takla Track and Timber Ltd. harvested 180 396 cubic metres and Takla Development Corp. harvested 82 205 cubic metres. From 1997 to 1999, Takla Development Corp. harvested an average of 94 610 cubic metres per year and Takla Track and Timber Ltd. harvested an average of 217 359 cubic metres per year. All of the timber harvested under these licences came from the Fort St. James Forest District.

TRC Cedar Limited and Chunzoolh Forest Products Limited each have a non-replaceable forest licence to harvest 40 000 cubic metres of hemlock/cedar stands (a temporary uplift to 50 000 cubic metres for Chunzoolh and 80 000 cubic metres to TRC was awarded in 2000). In 2000, TRC Cedar harvested 85 926 cubic metres and Chunzoolh harvested 138 111 cubic metres. TRC's and Chunzoolh's average annual harvests over the period 1997 — 2000 fell within their uplifted AACs.

The seven replaceable minor timber sale licences (volumes less than 10 000 cubic metres of timber per year) in the TSA have a total AAC of 5810 cubic metres per year. In 2000, the harvest from these licences was 627 cubic metres. Between 1997 and 1999, 525 cubic metres and 9690 cubic metres were harvested in 1997 and 1999, respectively, while no timber was harvested in 1998. All of the volumes billed under these TSLs were harvested in the Prince George Forest District.

The Small Business Forest Enterprise Program has a total allowable annual cut of 1 627 273 cubic metres of timber per year. In 2000, SBFEP licensees harvested 1 543 230 cubic metres. From 1997 to 1999, an average of 1.46 million cubic metres of timber was harvested under the Prince George TSA SBFEP, and approximately 95% of this timber was milled within the Prince George TSA. The remaining 5% was shipped to other forest districts and regions. Over the same three-year period, an average of 44% of the SBFEP harvest came from the Prince George Forest District, 32% from the Fort St. James Forest District and the remaining 24% from the Vanderhoof Forest District.

Processing facilities

From 1998 to 2000, an average of 10.8 million cubic metres of timber was processed at about 30 solid-wood mills located throughout the Prince George TSA. Pulp mills in the Prince George Forest District processed an average of 2.16 million bone dry units of wood chips, most of which were by-products of solid wood mills within the TSA. The Prince George Forest District, which is home to 19 of the 30 mills, accounts for about 67% of the total timber and chip by-products processed within the TSA. The four mills in the Fort St. James Forest District and the three mills in the Vanderhoof Forest District consumed an average of 21% and 12%, respectively, of the total volume processed within the Prince George TSA.

Given the average 1998 to 2000 timber harvest of nine million cubic metres and the timber consumption of 10.8 million cubic metres of timber, the Prince George TSA is a net importer of fibre.

7.2.4 Forest sector employment and employment coefficients

The preceding harvesting and employment information is used to develop employment coefficients*, which are used to project future employment levels in the forestry sector. For this purpose, the forestry sector has been divided into three sub-sectors:

- harvesting and other woodlands-related employment including falling, log salvage, log scaling, log transport, harvest planning and administration;
- silviculture employment such as planting, surveying and other basic and intensive silviculture activities, such as spacing, fertilization and pruning*; and
- primary timber processing employment at lumber mills, veneer and plywood mills, shake and shingle mills, chip mills, log home mills, and pulp and paper mills.

The harvesting sub-sector of the forest industry includes both company and contract loggers and is the first sub-sector that would be affected by a change in the AAC. The predominant silvicultural system used in the Prince George TSA varies by company, but is mainly clearcutting using conventional ground-based skidder and fellerbunchers, with a small portion being harvested using cable and helicopter yarding systems. The active logging season runs from June or July through March, but varies by company and weather conditions.

The silviculture sub-sector is somewhat less tied to the current level of harvest, given that silviculture activities are ongoing for as much as 10-15 years following harvesting, although most silviculture activity occurs in the first two years after harvesting. Basic silviculture consists of pre-and post-harvest surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced, or intensive, silviculture includes spacing, fertilization and pruning. In the TSA, major licensees are responsible for basic silviculture on areas harvested under their licences. The provincial government is responsible for the remaining basic and all enhanced silviculture on Crown land, which is completed by silviculture contractors.

Employment data compiled for this Timber Supply Review indicate that from 1998 to 2000, the average TSA harvest of about nine million cubic metres per year supported about 2,600 person-years of direct harvesting and silviculture employment across the province. About 72% of this workforce resides in the Prince George TSA.

Processing employment

The timber processed at local mills comes not only from the Prince George TSA, but also from other forest districts in the Prince George Forest Region, tree farm licences, the Cariboo and Prince Rupert forest regions and other private sources. Subsequently, management areas other than the Prince George TSA support some of the processing employment within the Prince George TSA. The employment supported by these other units is not included in this report's employment estimates.

Employment data compiled for this Timber Supply Review indicate that, from 1998 to 2000, the TSA harvest of about nine million cubic metres per year supported approximately 4,600 person-years of direct processing employment across the province. About 94% of this processing employment is associated with operations within the Prince George TSA.

Forest Service employment

Three district offices located in Prince George, Vanderhoof and Fort St. James administer the Prince George TSA. Currently, about 230 people work in the forest district offices. Forest Service staff are involved in administration, enforcement of government policy, land-use planning and SBFEP-related planning for the Prince George TSA.

Employment coefficient
The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Pruning
The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.

Prince George TSA employment coefficients

Table 25 summarizes the employment supported by the 1997-1999 average harvest in the Prince George TSA and the corresponding employment coefficients. These coefficients have been calculated for the TSA and province to highlight the level of forestry activity within the Prince George TSA and to identify the contribution that the Prince George TSA's forestry sector makes to the provincial economy. The two employment levels are defined as follows:

1. TSA employment and employment coefficients, which comprise residents of the Prince George TSA who are employed in the forestry sector within the Prince George TSA and who rely on the Prince George TSA timber supply; and
2. Provincial employment and employment coefficients, which comprise all forestry sector employment in the province that relies on the Prince George TSA timber supply, including both residents of the Prince George TSA and those who live elsewhere.

Employment is divided into direct, indirect and induced components; the sum of the components is the total impact. The coefficients are expressed as the number of full-time jobs, or person-years, per 1000 cubic metres of timber harvested. Indirect and induced employment figures were derived using employment multipliers.[9]

More detailed information regarding employment coefficients and multipliers is presented in Appendix B, "Socio-Economic Analysis Background Information."

Table 25. Prince George TSA employment and employment coefficients,[10] average 1996–1998

Forest industry activity	TSA employment (person-years)	TSA coefficients (person-years/'000s m³)	Provincial employment (person-years)	Provincial coefficients (person-years/'000s m³)
Harvesting	1,505	0.17	1,860	0.21
Silviculture	355	0.04	705	0.08
Processing	4,255	0.48	4,520	0.51
Total direct	6,115	0.69	7,085	0.80
Indirect + induced	4,695	0.53	8,770	0.99
Total employment	10,810	1.22	15,855	1.79

Note: Employment estimates are reported in person-years based on survey data collected for 1996–1998. The data in this table are based on average 1996-1998 employment levels and the average 1996-1998 Prince George TSA harvest of 8 861 191 cubic metres.

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(9) British Columbia Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables. Victoria, British Columbia.

(10) Other employment coefficients may be found in other documents for the same or similar areas. A difference in ratios can occur for several reasons, such as using different sources of employment data and rounding of estimates, dividing employment by a different harvest level, using a different definition of a full-time position and changing the definition of forestry sub-sectors. However, the size of impacts associated with a timber supply change should illustrate similar effects.

7.2.5 Prince George TSA employment income

In 1998, the average income for forest sector employees in the Prince George TSA was approximately $46,690 per year, based on average provincial income levels for logging and forestry services, solid wood manufacturing, and pulp and paper manufacturing (see Appendix B for average incomes for forest industry sub-sectors). Average income for indirect and induced sector employees was $34,070 per year. The total direct income associated with the forest sector in the Prince George TSA averaged $330.8 million per year and total income for indirect and induced employment averaged $298.8 million per year (incomes are reported in 1998 dollar values). Combined, total employment income associated with the Prince George TSA harvest averaged $629.6 million per year. Table 26 shows average annual wages and salaries, total income levels and total income per 1000 cubic metres.

Table 26. Average direct and indirect/induced incomes and total employment income, 1996-1998

	Average wage (1998 dollar value)	Total income ($ millions)	Total income ($/'000s m^3)
Direct	46,690	330.8	37,330
Indirect + induced	34,070	298.8	33,720
Total income		629.6	71,050

Sources: Statistics Canada. Annual estimates of employment, earnings and hours. Internet, www.statcan.ca/start.html.
Statistics Canada. Labour Force Survey, average weekly wage rate. Internet, www.statcan.ca/start.html..

7.2.6 Provincial government revenues

The provincial government receives various taxes and other revenues from the forest industry. The forest industry pays stumpage, royalties and rents to the provincial government for the rights to timber and its use, and other industry operating taxes such as corporate income, property and sales taxes. The provincial and federal governments also receive revenues from forestry employees through income taxes.

From 1996 to 1998, forest industry activity in the Prince George TSA led to an average of approximately $329.7 million in stumpage and rent payments to the provincial government. Other government revenues from forest industry taxes accounted for $80.0 million and total employment supported by the Prince George TSA harvest contributed total provincial and federal income taxes worth $164.2 million, approximately one-third of the income tax, or $54.7 million, goes to the provincial government. Table 27 shows average provincial government revenues for 1997 to 1999.

Table 27. Average provincial government revenues, 1996-1998

	Average revenue 1996-1998 ($1998 millions)	Revenue ($/'000s m^3)
Stumpage, rents and royalties	329.7	37,086
Industry taxes	80.0	9,037
Provincial income tax	54.7	6,173
Total government revenues	464.4	52,296

Sources: Ministry of Forests, Revenue Branch; PricewaterhouseCoopers, 1999.

7.3 Socio-economic implications of the base case harvest forecast

The socio-economic analysis focuses on harvest level changes in the short to mid-term (10-20 years from now) and considers:

- the implications of alternative harvest levels for both the Prince George TSA and the province;
- possible impacts on communities within the TSA;
- timber requirements of processing facilities within the Prince George TSA; and
- regional timber supply implications.

The socio-economic analysis considers average levels of forest industry related activity that the base case harvest forecast could support. Impacts associated with future harvest levels are calculated using employment, income and revenue coefficients (per 1000 cubic metres). This method assumes that the current role of the forest industry in the provincial economy and labour productivity will not change. In other words, employment levels in the future can be predicted based on today's relationship between employment and the volume of timber harvested and processed. The analysis also assumes that the proportions of harvesting, silviculture and timber processing employment will remain constant and that the types and proportions of wood products manufactured will remain the same.

While this method is reasonably accurate for short-term forecasts (within the next five years), employment coefficients 20 years from now may differ due to changes in market conditions, timber processing technologies, etc. The analysis indicates the size of impacts to employment, employment income and provincial government revenues, within a constantly changing socio-economic environment.

7.3.1 Short- and long-term implications of alternative harvest levels

Prince George TSA employment and income impacts

Prince George TSA employment and income impacts focus on those workers who are supported by the TSA harvest and who reside within the TSA. Workers who come to the TSA to work but who reside outside the TSA are included in the provincial impact section, as are those supported by Prince George TSA timber processed at mills outside the TSA. Table 28 indicates the employment and income that the current AAC could support if fully harvested and processed.

From 1998 to 2000, the average annual harvest level was 9 049 583 cubic metres. The current AAC is 9 363 661 cubic metres. While the 1998-2000 average annual harvest level is below the AAC, it is well within the allowance for cut-control variations of plus or minus 10% per five-year cut control period. The full AAC allotment was taken during the 1993-1997 cut control period and harvesting the full AAC is expected in the current cut control period ending in 2002. The current average harvest rate is within 5% of the current AAC. As such, this assessment is based on the assumption that the forest sector is achieving its full potential and will operate at or near full employment, given normal fluctuations in harvest rates.

Full employment will likely range between the current 1998-2000 average level and what would be supported by harvesting the full AAC. The TSA can support between about 6,250 and 6,450 person-years of direct employment and a further 4,800 to 4,960 person-years of indirect and induced employment within the TSA. This level of employment would result in about $455 to $470 million in annual total employment income.

Given the long-term stability of the timber supply as indicated by the timber supply forecast, it is assumed that employment associated with the Prince George TSA will remain at or near its current level. Annual employment will experience marginal fluctuations as harvest levels rise and fall with market conditions. A change in the demand for wood products or manufacturing productivity may also affect the total employment supported by the forest sector.

Provincial employment and income impacts

Provincial employment and income impacts include all the activity supported by the Prince George TSA harvest, regardless of processing location and place of residence.

The Prince George TSA will support a range of employment across the province. The current AAC of 9 363 661 cubic metres can support between about 7,240 and 7,490 person-years of direct employment and a further 8,960 to 9,270 person-years of indirect and induced employment across the province. This level of employment results in $643 to $665 million in total provincial employment income per year.

Given the long-term stability of the timber supply, employment levels are assumed to remain approximately the same. However, the number of person-years supported by the timber supply will fluctuate with the annual harvest rate. How this employment impact is manifested depends on how each company responds to the change and the volume in question.

Table 28. Prince George TSA socio-economic impacts: base case harvest forecast[a]

		Base case harvest forecast	
	Average harvest 1998–2000	**Less hemlock/cedar partition**	**Including hemlock/cedar partition**
Timber supply ('000s m³)	9 363 661	9 073 661	9 363 661
Harvest level (1998-2000 average)	9 049 583		
Difference from current AAC	215 911		
Prince George Timber Supply Area			
Employment		**(person-years)**	
Direct	6,245	6,260	6,460
Indirect + induced	4,795	4,810	4,960
Total	11,040	11,070	11,420
Range[b] of employment gain (loss)			342-380
Employment income		**($1999 million per year)**	
Direct	291.6	292.3	301.6
Indirect + induced	163.4	163.9	169.0
Total	455.0	456.2	470.6
Range of income gain (loss)		1.1-1.2	14.0-15.6
Province[c]			
Employment		**(person-years)**	
Direct	7,240	7,260	7,490
Indirect + induced	8,960	8,980	9,270
Total	16,200	16,240	16,760
Range of employment gain (loss)		35–40	487–560
Employment income		**($1999 million per year)**	
Direct	338.0	339.0	349.7
Indirect + induced	305.3	306.0	315.8
Total	643.3	645.0	665.5
Range of income gain (loss)		1.5–1.7	19.3–22.2
Provincial government revenues		**($1999 million per year)**	
Stumpage and related payments	335.6	336.5	347.3
Forest industry taxes	81.8	82.0	84.6
Employee income taxes	55.9	56.0	57.8
Total	473.3	474.5	489.7
Gain (reduction) in revenues		1.2	16.4

(a) Estimates for current employment in this table differ from those in Table 17. Employment figures in Table 20 are based on a 1998-2000 average annual harvest of 9 049 583 cubic metres, while the figures in Table 17 are based on the industry survey results with reference period 1997-1999 and an annual average harvest volume of 8 857 750 cubic metres.

(b) The ranges for employment and income changes account for employment insurance and other social assistance programs that provide temporary short-term income to unemployed or displaced workers. The range's upper limit assumes that all those who are unemployed or displaced leave the TSA to seek opportunities elsewhere and no longer spend any income locally, thus imparting a higher impact on the local economy than if they had not left. Alternatively, when employment increases, use of the range is based on the assumption that some of the new workers are already living within the TSA and are earning employment insurance or are at least spending some of their savings on consumer goods and services. The actual impacts of changes in harvest levels on employment and incomes will likely fall within the specified ranges. More details are provided in Appendix B.

(c) TSA employment and income estimates are included as part of the provincial employment and income estimates.

Government revenue impacts

Provincial government revenues from the forest industry include stumpage, royalties and rent payments, other taxes such as logging, corporate income, sales, property and electricity taxes, and income taxes from direct, indirect and induced employees. Under the existing tax and stumpage regimes, the current AAC of 9 393 661 cubic metres, if fully harvested, would provide on average approximately $490 million annually to the provincial government.

Provincial government revenues will remain much the same, assuming tax, stumpage, royalty and rent rates do not significantly change, and the allowable harvest remains at the level it is today.

7.3.2 Community-level impacts

The impacts related to changes in the timber supply can affect the socio-economic environment of a community. A reduction in employment and income could affect various socio-economic conditions in communities: for example, population growth rates, the size of the labour force, economic development opportunities and government-funded services. These changes would have a greater effect on an economy dependent on a single industry than on one that is more diversified and growing in other sectors.

The Prince George TSA is separated into relatively distinct forest districts: Fort St. James, Vanderhoof and Prince George. As a result, any change to the TSA's timber supply would affect the districts somewhat differently. The City of Prince George, while a major contributor to the TSA's economy, is the regional supply and service centre and would be vulnerable to changes in the Prince George TSA and in other areas of northern British Columbia. However, the city's diversity also means that it would be more resilient than other northern British Columbia communities. Conversely, Fort St. James, Vanderhoof and Fraser Lake rely much more on the primary industries of forestry and mining, and less on service industries. As such, the closure of a mill would be felt in any community, but much more in forestry-dependent districts.

Given the strength of the timber supply forecast, the Prince George TSA timber supply is likely not going to be the cause of any major harvesting- and mill-related impacts. Changes that could affect the region and its communities are not only related to the timber supply, however, but also to market and trade issues.

7.3.3 Nature, production capabilities and timber requirements of processing facilities

The current milling structure of the Prince George TSA consists of 19 lumber mills, 15 of which process over 300 000 cubic metres of timber per year. The TSA is also the location of three pulp mills, one paper mill, two chip mills, one pole mill and a veneer plywood mill. Of the 27 mills in the entire Prince George TSA, 19 mills are in the Prince George Forest District.

From 1998 to 2000, the average annual volume of logs processed by local solid wood mills was about 10.8 million cubic metres. The three pulp mills processed an annual average of 2.16 million bone dry units (BDUs) of chips. Approximately 70% of the chip supply for Prince George pulp mills comes from solid wood mills located in the TSA.

The Prince George TSA's current, 1998 to 2000, average annual harvest of 9 049 583 cubic metres represents about 80% of the total timber volume consumed at local mills. TSA mills rely on sources of timber beyond the Prince George TSA, and as such are vulnerable to changes in the timber supplies of other districts.

7.3.4 Regional timber supply issues

The regional timber supply is an important consideration when examining potential future impacts associated with timber supply changes. The Prince George Forest Region supplies timber to mills throughout the northern half of the province and some in the southern Interior and coast.

Over the next 25 years, timber supply forecasts indicate that the average annual harvest in the Prince George Forest Region could remain relatively constant around 19 to 20 million cubic metres.[11] The Prince George Forest Region has the most stable timber supply in the province.

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(11) The current AAC for the Prince George Forest Region totals 19 400 299 cubic metres; by approximately 2020, current timber supply forecasts indicate that the timber supply in the Prince George region could be approximately 19.8 million cubic metres per year.

7.4 Summary

The forest industry in the Prince George TSA is an important source of employment and income for local residents. The TSA also supplies timber to mills in other districts of the Prince George, Prince Rupert, Kamloops and Cariboo forest regions. Other sectors important to the local economy include the public sector and the travel sector.

The current AAC of 9 363 661 cubic metres, if fully harvested and processed, can support about 7,500 person-years of direct forestry employment and a further 9,270 person-years of indirect and induced employment across the province. Residents of the Prince George TSA account for about 86% of the direct employment. The employment income associated with this direct, indirect and induced employment is about $665 million per year.

The provincial government collects about $470 to $490 million per year, depending on the level of harvest, in stumpage and related payments, other industry taxes and provincial income taxes.

The timber supply in the Prince George Timber Supply Area should provide stability for the region's timber industry, although annual fluctuations due to market and other trade conditions will continue to affect those working at the margin of timber operations.

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9 Glossary

Analysis unit	A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.
Base case harvest forecast	The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.
Biodiversity (biological diversity)	The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Biogeoclimatic (BEC) variant	A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.
Biogeoclimatic zones	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Clearcutting with reserves	A variation of the clearcut silvicultural system in which trees are retained, either uniformly or in small groups, for purposes other than regeneration.
Cutblock	A specific area, with defined boundaries, authorized for harvest.
Cutblock adjacency	The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.
Deciduous	Deciduous trees shed their leaves annually and commonly have broad-leaves.
Employment coefficient	The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.
Employment multiplier	An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.
Environmentally sensitive areas	Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.
Forest Practices Code	Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Free-growing	An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Green-up	The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Growing stock	The volume estimate for all standing timber at a particular time.

9 Glossary

Harvest forecast	The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.
Indirect and induced jobs	Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.
Integrated resource management (IRM)	The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.
Landscape-level biodiversity	The Landscape Unit Planning Guide provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.
Landscape unit	A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Long-term harvest level	A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.
Management assumptions	Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.
Not satisfactorily restocked (NSR) areas	An area not covered by a sufficient number of well-spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.
Old seral	Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.
Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Partition	A portion of the AAC that is attributable to certain types of timber and/or terrain.
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.
Protected area	A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).

9 Glossary

Pruning	The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Site index	A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.
Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
Timber harvesting land base	Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.
Volume estimates (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.
Woodlot licence	An agreement entered into under the Forest Act. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.

Appendix A

Description of Data Inputs and Assumptions for the Timber Supply Analysis

Introduction

In December of 1998 a data package for the Prince George Timber Supply Area timber supply review was released for public review. As a result of public input, a number of data and management assumptions have been revised. This appendix presents the revised data package used to produce the timber supply analysis.

The following tables and commentary outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Prince George TSA timber supply analysis. This information represents current forest management in the area. Current management is defined as the set of land-use decisions and forest and stand management practices currently implemented and enforced. Future forest management objectives, that may be intended, but are not currently implemented and enforced, are not included in this appendix. The purpose of the timber supply review is to provide information on the effects of current management on both short- and long-term timber supply in each timber supply area in the province. Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

A.1 Inventory Information

A.1.1 Standard and non-standard Inventories

The inventory information used in this analysis combines the Ministry of Forests forest cover inventory for the Prince George TSA with non-standard overlays added to provide information of forest conditions as well as the management considerations listed in Table A-1.

A.1 Inventory Information

Table A-1. Inventory information

Data	Source	Vintage	Update	Source Scale
Standard				
Forest cover	Ministry of Forests (MoF) —Fort St. James, Prince George, Vanderhoof	1990 – 1993 [except North Sustut (1975) and PG SSA (1978)]	1992 – 1998 1993 – 1997 1994 – 1997	1:20 000
Biogeoclimatic	MoF — Research Branch	1993	1996	1:250 000
Non-standard				
Natural disturbance type (NDT)[a]	MoF — Forest Practices Branch	1993	1996	1:250 000
Visual landscape inventory	MoF — Prince George Forest Region, Fort St. James, Prince George, Vanderhoof	1994	1998	1:250 000 1:250,000 and 1:50,000 1:100 000
Land and resource management plans (LRMP) resource management zones	LUCO	1996 1996 1995	1997 1997 1998	1:250,000 1:250,000 1:50,000
Protected areas (from the LRMPs)	MoF and Ministry of Environment, Lands and Parks (MELP) — Fort St. James, Prince George Vanderhoof	1996 1996 1995	1997 1997 1996	1:20,000 1:20,000 1:50,000
Draft landscape units	MoF and MELP — Fort St. James, Prince George, Vanderhoof	1996	1997	1:50 000
Lakeshore classification (lakeshore riparian area buffers)	MoF — Fort St. James, Prince George, Vanderhoof	1998 1997 1998		1:20,000
Caribou habitat	MELP	1995	1997	1:50,000
Crown Land Plan (Vanderhoof and Prince George Districts)	BCAL	1995	1997	1:20,000
Heritage trails	MoF — Vanderhoof and Fort St. James	1996	—	1:20,000
Research forests: John Prince (UNBC), Aleza Lake and Blue Mountain	UNBC, MoF Region and MoF Vanderhoof	1995	1995	1:20,000
Eco-sections	MELP	1995	1995	1:50,000
Herrick LRUP	MoF—Prince George Forest District	1993	—	1:20,000

(continued)

Table A-1. Inventory information (concluded)

Data	Source	Vintage	Update	Source Scale
Updates for disturbance	MoF — Prince George Region	1996	—	1:20,000
Operability (harvest system)	MoF — Prince George Region	1996	1997	1:20,000
McLeod Lake Treaty 8 Adhesion Area	MoF — Prince George Region	1997	—	1:20,000
Planning cell	MoF — Prince George Region	1992	1997	1:20,000
Woodlot update	MoF — Prince George Forest Region	1996	1998	1:20 000

Data source and comments:

Forest cover

The forest inventory file will be projected for growth to 1998. Harvest depletions are current to 1995 through the use of the non-standard update for disturbance layer prepared for the Prince George TSA Committee.

Biogeoclimatic ecosystem classification (BEC)

BEC information was supplied by the Ministry of Sustainable Resource Management.

Visual landscape inventory

Visual landscape inventory has been updated to reflect the Vanderhoof LRMP scenic area recommendations and current practice. In the Prince George and Fort St. James Forest Districts, scenic values that have been made known are reflected in the timber supply analysis.

Draft landscape units

Although the landscape unit boundaries have not yet been approved, this layer is available for use in the analysis.

Operability

See Sections A.3.7 Inoperable – physical and A.3.8 Inoperable - economic

Woodlots

The woodlot licences contained in the ownership coverage in the forest inventory file are best current mapping information and do not reflect all of the woodlots awarded to date. The woodlot coverage ensures all woodlots are accounted for.

A.2 Zone and Analysis Unit Definitions

A.2.1 Management zones (groups)

Management zones represent areas with distinct management emphasis. For example, a zone may be based on a harvesting system, silviculture system, visual quality objective or wildlife consideration. Some areas may be subject to more than one management objective. Grouping enables the analyst to apply overlapping constraints to such areas.

Table A-2. provides general descriptions of the management objectives and related information to be tracked in the analysis. The non-contributing forest (i.e., forested land not available for timber harvesting) is included for consideration in attaining forest cover objectives for landscape-level biodiversity, community watersheds, caribou habitat, visual quality objectives and the Vanderhoof LRMP special management zone. Further information on the forest cover requirements to be applied to these areas can be found in Section A.4.10, "Forest cover requirements."

Table A-2. Objectives to be tracked

Zone/group	Management strategy
Forest district	Harvest contribution by each of the three forest districts in the TSA is examined. Many management considerations are made for each district separately.
Landscape-level biodiversity	Seral stage requirements are to be managed based draft landscape units (LUs), biogeoclimatic zones (BEOs) and natural disturbance types (NDTs).
Land and resource management plans (LRMP) — resource management zones (RMZ)	LRMP RMZs will be assessed as current practice.
Visual quality objectives (VQO)	Limits are placed on the amount of forest that can be disturbed in an area managed for visual quality.
Caribou habitat	Caribou habitat: high, medium, and, corridors.
Crown land plans	Crown land plans exist for Prince George and Vanderhoof. Many zone classifications are excluded from contributing to the timber harvesting land base.
Aleza Lake, UNBC and Blue Mountain research forests	The Aleza Lake and John Prince (UNBC) research forests are now under special use permits. They may or may not contribute to the TSA harvest level.
Herrick local resource use plan	Within the Prince George Forest District — reserves; special management study areas; special management areas — forest ecosystem networks; commodity emphasis forest.

Data source and comments:

See Section A.1, "Inventory Information," for the sources of the management zone information mentioned above.

A.2 Zone and Analysis Unit Definitions

A.2.2 Analysis unit characteristics

An analysis unit represents forest stands with similar tree species (as indicated by the inventory type group), similar timber growing capability (as indicated by the site index in the forest inventory file) and similar management regimes. Each analysis unit was assigned its own timber volume projection (growth curve).

Yield tables for existing natural stands were derived using the variable density yield prediction (VDYP) yield model. Yield tables for recent plantations and future stands were derived using the table interpolation program for stand yields (TIPSY).

Table A-3. Definition of analysis units and timber harvesting land base for the base case by forest district

Leading tree species	Inventory type groups	Analysis unit number			Timber harvesting land base (hectares) by district		
		Prince George	Vanderhoof	Fort St. James	Prince George	Vanderhoof	Fort St. James
Fir	1-8	1001	2001	3001	23 690	4 103	11 113
Cedar	9-11	1002	N/A	N/A	23 688	0	0
Hemlock	12-17	1003	N/A	N/A	12 061	0	0
Balsam	18-20	1004	2004	3004	109 694	5 041	218 151
Spruce (SI ≥ 12)	21-26	1005	2005	3005	474 996	53 976	233 321
Spruce (SI < 12)	21-26	1006	2006	3006	99 772	31 430	80 240
Pine	28-31, 34	1007	2007	3007	499 512	658 198	552 791
Deciduous	35, 36, 40, 41, 42	1008	2008	3008	0	0	0
High elevation ESSF (balsam and spruce >.1200 m)	18-26	1009	2009	3009	82 750	31 693	181 689
All					1 326 372	784 441	1 277 305

Data source and comments:

Pine in Vanderhoof (AU 7) contains 42 316 hectares of what is considered to be small pine (average piece size less than 0.2 cubic metres per tree). In the FSSIM files this is referenced as analysis unit number 2017. This stratum supports the current L&M Lumber small pine licence. Small pine regenerates to the normal pine analysis unit (2107).

Managed stand (TIPSY) analysis units are numbered by adding 100 to all of the above.

Timber yields are developed for each of the analysis unit/forest district combinations.

Site index (SI) (for spruce analysis units) is the height, in meters, at breast height at age 50 years.

A.3 Definition of the Timber Harvesting Land Base

This section describes the steps taken to establish the timber harvesting land base. Subsections following are in order of the reductions shown in Table 2.

A.3.1 Land not owned and administered by the province of British Columbia, private forest land, leases

The total land base is stratified into various ownership codes. Land must be Crown land under provincial administration for it to contribute to the land base used to determine timber supply. However, even some areas under provincial administration, such as woodlot licences, do not contribute to timber supply in this analysis. The following ownership types within the TSA were not considered to contribute to the timber harvesting land base or other forest management objectives in the TSA, and were excluded from the land base modeled in the analysis:

Table A-4. Ownership categories that do not contribute to the timber harvesting land base or other forest management objectives in the Prince George TSA

Ownership code	Definition
40N	Private Crown grant
50N	Federal reserve
52N	Indian reserve
99N	Small leases

A.3.2 Woodlot licences

Woodlot licences are managed for timber production but are administered separately from the TSA. While the Minister of Forests initially apportions a part of the TSA AAC to woodlots, once an AAC is allocated to a specific woodlot licence, the area and the associated AAC are no longer administered as part of the TSA. Consequently, allocated woodlots do not contribute to the TSA timber harvesting land base.

Ordinarily, ownership code '77N' is used to identify these areas. However, the three districts in the Prince George TSA provided new woodlot mapping for use in the timber supply analysis (see Table A-1., "Inventory information"), and this information was used to supplement the forest cover ownership mapping. Using the new woodlot mapping, 67 635 additional hectares of woodlot licences have been identified. These areas are excluded from the timber harvesting land base.

At the time the Prince George timber supply analysis was undertaken, the total volume allocated to woodlot licences was 100 000 cubic metres per year. This woodlot licence volume has been deducted from the total AAC of the Prince George TSA, resulting in the current AAC volume used in the analysis.

A.3.3 Land classified as non-forest or non-productive forest

Alpine, lakes, rock, etc., represented by inventory type identities 6 and 8, were excluded from the timber harvesting land base.

A.3.4 Non-commercial cover

Type identity 5 represents areas which when inventoried were occupied by non-commercial brush species. These areas are considered to be unlikely sites for timber production. Non-commercial cover areas are not equivalent to not satisfactorily restocked (NSR); that is, they are not generally the result of past harvesting . There are currently no initiatives to re-forest non-commercial brush, other than small areas within harvest blocks. The overall area rehabilitated is not significant in terms of TSA timber supply. All areas classified as non-commercial cover will be deducted from the land base that contributes to timber supply.

A.3.5 Land not administered by the British Columbia Forest Service for timber supply

Land under provincial Crown administration may contribute to forest management objectives even if it is not available for timber harvesting. For example, provincial park land provides old-growth to help achieve biodiversity objectives. Areas with the following ownership codes do not contribute to timber supply in the analysis, but are considered in the assessment of forest cover requirements.

Table A-5. Ownership categories that are excluded from the timber harvesting land base but contribute to some forest management objectives

Ownership code	Definition
60N	Crown / ecological reserves
61C, 61N	UREP (use, recreation, enjoyment of the public)
63N	Class A parks
67N	Provincial parks, park equivalents, or reserves
99C	Miscellaneous leases

Of the provincial Crown ownership codes occurring within the Prince George TSA, only the following are considered to contribute to timber supply for harvest forecast and AAC determination purposes:

Table A-6. Ownership categories that are included in the timber harvesting land base

Ownership code	Definition
62C	Crown forest management unit
69C	Large Crown reserves
69N	Small Crown reserves (less than 100 hectares)
70N	Old Timber licences

Timber licences are old tenure arrangements that give a licensee exclusive rights to harvest merchantable timber within the licence area and do not contribute to the TSA allowable annual cut. Once these areas have been harvested, regenerated and attain free-growing status, the timber licence area reverts to Forest Service jurisdiction. Accordingly, these areas are included in the timber harvesting land base after the first harvest and contribute to the TSA harvests in medium- to long-term timber supply.

Timber licence areas need to be accounted for from the time the stands have been harvested, and/or from the time stands are estimated to be harvested. Time of harvest is used as the reference point so that the impact of these harvests on forest cover requirements is given full consideration in the timber supply analysis. In some cases stands that have been harvested and legally reverted have not had the necessary ownership change on the inventory file (e.g., change from 70-N to 62-C).

Only one timber licence appears in the forest inventory file for this TSA. This licence expired in 1996 and was in the Prince George Forest District. The inclusion of ownership 70-N in the timber harvesting land base will ensure this area contributes to future timber supply in the TSA.

A.3.6 Environmentally sensitive areas

Some forest lands may be environmentally sensitive and/or significantly valuable for other resources. These areas are identified and delineated during a forest inventory and are called environmentally sensitive areas (ESAs). The ESA system uses the following categories: soil (S), forest regeneration problems (P), management problems (C), snow avalanche (A), recreation (R), wildlife (W), and water (H). With the exception of avalanche (A) and management problems (C), two ESA classes are recognized within each category: high (1) and moderately (2) sensitive.

In the context of timber supply analysis, environmental sensitivity may reduce the harvesting opportunity, or preclude harvesting. The modelling strategies used to account for ESAs are: per cent area reductions, and the specific evaluation of individual ESA polygons for harvesting opportunity.

Table A-7. Description of environmentally sensitive areas

		Per cent reduction (%)		
ESA category	**ESA description**	**Prince George**	**Vanderhoof**	**Fort St. James**
A1	Snow avalanche	N/A	N/A	90
P1	Regeneration problems high	90	75	90
P2	Regeneration problems moderate	30	N/A	N/A
R1	Recreation high sensitivity	100	25	100
R2	Recreation moderate sensitivity	30	25	30
S1	Soil high sensitivity	80	80	90
S2	Soil moderate sensitivity	50	80	80
W1	Wildlife high sensitivity	90	20	90
W2	Wildlife moderate sensitivity	80	20	30
C1	Areas with management problems (This classification was used in PSYUs surveyed prior to 1976. After which C is replaced by P and A).	N/A	N/A	90

Data source and comments:

The lower per cent reductions for most categories for the Vanderhoof Forest District compared to the Prince George and Fort St. James Forest Districts are due primarily to the proportionately higher amount of area of ESAs in Vanderhoof that are classified as highly sensitive (ESA1). In a review of ESAs, MoF and MSRM staff determined that some of the ESA1 areas in the Vanderhoof Forest District are in fact ESA2, and subject to lower restrictions on harvests. In all cases, the land base reduction factors are based on the MoF/MELP review, and reflect conditions in the respective forest districts. If more than one classification exists for an area then the one with the highest reduction is applied.

A.3.7 Inoperable — physical

Operability and inoperability codes are generally used to describe the presence or absence of physical barriers or limitations to harvesting, and the logging methods (e.g., cable) most suitable for an area. Air photo terrain classification was done in support of a harvesting system inventory. Areas totalling 15 986 hectares that indicated potential slope failure were delineated as being physically inoperable and excluded from the timber harvesting land base.

A.3.8 Inoperable — economic

Harvesting system mapping, based on physical terrain and soil types, has been incorporated into the database for the entire TSA. Economic operability is included in Table A-8 through definition of a minimum volume per hectare threshold, which excludes 281 026 hectares from the timber harvesting landbase.

Table A-8. Criteria for defining economic operability for mature stands (applies to stands greater than 140 years old

		Per cent reduction based on minimum volume per hectare			
Inventory operability description	**Operability code**	**< 140 m³/hectare**	**140 to 200 m³/hectare**	**201 to 250 m³/hectare**	**> 250 m³/hectare**
Conventional (ground)	A	100	0	0	0
Mixed (conventional / cable)	M	100	100	0	0
Cable or helicopter	C	100	100	100	0

A.3.9 Unmerchantable — mature

Unmerchantable mature forest types are stands or sites with non-commercial species, insufficient stocking, insufficient height, or a combination of these that causes the stand to be undesirable. Deciduous forest areas are not currently harvested and are removed from the timber harvesting land base. Tables A-9. and A-10. summarize the inclusions of forest types by forest district and operability class. A factor of 100 signifies inclusion in the timber harvesting land base, and a 0 signifies full exclusion.

Leading cedar and hemlock stands are not included in the base case but these stands are being harvested as part of a partitioned uplift of 290 000 cubic metres per year to address hemlock looper damaged stands. Table A-10 indicates, based on experience with current salvage operations, the definition of economic cedar and hemlock stands

Table A-9. Criteria for defining merchantable mature stands — per cent inclusion into the timber harvesting land base

	Forest district:	**Prince George**			**Vanderhoof**			**Fort St. James**		
	Logging system:	**Conv**	**Mix**	**Cable**	**Conv**	**Mix**	**Cable**	**Conv**	**Mix**	**Cable**
Type group number (leading species)	**Age, height and stocking class**									
1-8	Age ≥ 6, Ht ≥ 3, Stock = 1	100	100	100	100	100	100	100	100	0
(Douglas-fir)	752, 852, 952, 742, 842, 942	100	100	100	100	100	100	100	100	0
	732, 832, 932	100	100	0	100	100	0	100	100	0
	721, 821, 921	100	100	0	100	100	0	100	100	0
	722, 822, 922	0	0	0	0	0	0	0	0	0
	Age ≥ 7, Ht = 1, All stock	0	0	0	0	0	0	0	0	0
18-20	Age ≥ 6, Ht ≥ 3, Stock = 1	100	100	100	100	100	100	100	100	100
(Balsam)	642, 742, 842, 942	100	100	100	100	100	100	100	100	100
	632, 732, 832, 932	100	100	0	100	100	0	100	100	0
	621, 721, 821, 921	100	100	0	100	100	0	100	100	0
	622, 722, 822, 922	0	0	0	0	0	0	0	0	0
	Age ≥ 6, Ht = 1, All stock	0	0	0	0	0	0	0	0	0
21-26	Age ≥ 7, Ht ≥ 3, Stock = 1	100	100	100	100	100	100	100	100	100
(Spruce)	642, 742, 842, 942	100	100	100	100	100	100	100	100	100
	632, 732, 832, 932	100	100	100	100	100	100	100	100	100
	621, 721, 821, 921	100	100	0	100	100	0	100	100	0
	622, 722, 822, 922	0	0	0	0	0	0	0	0	0
	Age ≥ 6, Ht = 1, all stock	0	0	0	0	0	0	0	0	0
27-31	Age ≥ 5, Ht ≥ 3, Stock = 1	100	100	100	100	100	100	100	100	100
(Pine)	542, 642, 742, 842, 942	100	100	100	100	100	100	100	100	100
	532, 632, 732, 832, 932	100	100	0	100	100	0	100	100	0
	533, 633, 733, 833, 933	100	100	0	100	100	0	100	100	0
	534, 634, 734, 834, 934	0	0	0	0	0	0	0	0	0
	521, 621, 721, 821, 921	100	0	0	100	0	0	100	0	0
	522, 622, 722, 822, 922	0	0	0	100	0	0	0	0	0
	523, 623, 723, 823, 923	0	0	0	100	0	0	0	0	0
	524, 624, 724, 824, 924	0	0	0	0	0	0	0	0	0
	Age ≥ 5, Ht = 1, all stock	0	0	0	0	0	0	0	0	0
35-42	All age, height and stock	0	0	0	0	0	0	0	0	0
(Deciduous)										

Table A-10. Criteria for defining merchantable mature cedar and hemlock stands

	Forest district:	**Prince George**			**Vanderhoof**			**Fort St. James**		
	Logging system:	**Conv**	**Mix**	**Cable**	**Conv**	**Mix**	**Cable**	**Conv**	**Mix**	**Cable**
Type group number (leading species)	**Age, height and stock class**									
9-11 (Cedar)	Age ≥ 7, Ht ≥ 3, Stock = 1	100	0	0	0	0	0	0	0	0
12-17 (Hemlock)	Age ≥ 7, Ht ≥ 3, Stock = 1	100	0	0	0	0	0	0	0	0

A.3.9 Unmerchantable — juvenile stands

Juvenile stands will grow to be either timber harvesting land base or will be forested exclusions. The following table shows the minimum site index required for a stand to qualify as timber harvesting land base.

Table A-11. Criteria for defining merchantable juvenile (immature) stands

		Minimum site index for inclusion in timber harvest land base				
Inventory operability description	**Operability code**	**Douglas-fir age class < 7 (< 140 years)**	**Cedar/hemlock age class < 7 (< 140 years)**	**Balsam age class < 6 (< 120 years)**	**Spruce age class < 7 (< 140 years)**	**Pine age class < 5 (< 100 years)**
Conventional	A	12.9	10.8	9.2	8.3	8.5
Mixed conventional/cable	M	15.1	N/A	11.5	10.3	10.7
Cable	C	16.9	N/A	13.3	12.4	12.8

The site index thresholds were derived using VDYP, and represent the index at which a minimum volume per hectare is predicted to be achieved by 140 years of age. A – 140 cubic metres per hectare; M – 200 cubic metres per hectare; C – 250 cubic metres per hectare.

A.3.10 Visual preservation zone — Sustut LRUP

The Sustut Local Resource Use Plan (LRUP) proposed that the area surrounding the Sustut and Bear Rivers in the northern part of the Fort St. James Forest District be preserved in its natural state. This direction was endorsed by the Fort St James Land and Resource Management Planning table (LRMP) and adopted into the plan.

This resource management zone (Lower Sustut RMZ) receives the most recreational use in the upper Skeena watershed. The Sustut River is a Class 1 classified water, which means angling use is specially regulated. A combination of high natural resource values (water quality, natural beauty of the landscapes, wildlife, and remoteness) results in uncrowded conditions and exceptional fishing, attracting anglers from around the world to the Sustut River.

There is considerable fly-in fishing use in many places. Suskeena Lodge is located on the Sustut River and is accessible only by air. This lodge offers full accommodations, as well as hunting, fishing, and guiding services. Steelhead Valhalla Lodge, located on the Sustut River, is accessible only by air and offers accommodations, boat rentals and fishing services. Two guiding licenses and three trapping licenses are registered in the zone.

Preservation of this area removes 1296 hectares from the timber harvesting land base.

A.3.11 Critical caribou habitat in the Prince George and Fort St James Forest Districts

Interim agreements have been established between MoF and MWLAP to protect critical caribou habitat in the Prince George and Fort St James Forest Districts. A Caribou management plan for the Vanderhoof Forest District is very nearly completed with MoF and MWLAP sign-off expected in the summer of 2001. For the Prince George Forest District and the area protecting the Takla herd in the Fort St. James Forest District (Mitchel Range, Mt Blanchet and Mt Sydney Williams) there is to be no commercial timber harvesting in areas classified as 'caribou high' until proven management strategies are developed in medium caribou habitat. For this timber supply review, and until suitable management strategies are established, analysis will exclude high habitat from the timber harvesting land base. There are 113 871 hectares excluded from the timber harvesting land base to ensure protection of critical caribou habitat.

A.3.12 Roads, trails and landings

Separate estimates are made to reflect the loss in productive forest land due to existing and future roads, trails and landings. Existing roads, trails and landings estimates are applied as reductions to the current productive forest considered available for harvesting, and future roads, trails and landings reductions are applied after stands are harvested for the first time in the simulation model. Sources of estimates for roads, trails and landings include data from; ground based surveys, information from Integrated Silviculture Information System (ISIS) and Major Licensee Silviculture Information System (MLSIS) records and advice from district engineering staff. Since a portion of each district has already been accessed (that is, the main haul roads have been constructed), future losses percentage will somewhat lower than existing losses percentage. Reductions for existing roads, trails and landings total 20 759 hectares of timber harvesting land base. Future roads trails and landing reductions remove 149 438 hectares from the timber harvesting land base.

Table A-12. Estimates for existing roads, trails, and landings

Forest district	Logging history	Within block productive loss (% of the timber harvesting land base)	Productive loss between blocks (% of the timber harvesting land base)
Prince George	Yes	4.6	N/A
	No	N/A	0.8
Vanderhoof	Yes	5.7	N/A
	No	N/A	0.3
Fort St. James	Yes	5.6	N/A
	No	N/A	0.3

Table A-13. Estimates for future roads, trails, and landings

Location	Logging history	Within and between block loss (% of the timber harvesting land base)
Prince George	No	3.8
Vanderhoof	No	4.4
Fort St. James	No	5.2

A.3.13 Lakeshore and wetland riparian reserves and management zones

Lakeshore areas and wetlands have been mapped and overlaid with the forest cover inventory for the analysis.

Management guidelines in lakeshore zones and wetlands are based on Table 11 in the *FPC Riparian Management Area Guidebook* and are summarized in Table A-14.

A 100% reduction will be applied to lakeshore reserves. For lakeshore management zones it is the intention to retain a maximum of 10% of the stand volume. For this timber supply review a 10% reduction to the timber harvesting land base was applied to lakeshore and wetland management zones. The December 1998 data package indicated 25% of stand volume was being retained in management zone but current performance is to retain 10% of the stand volume and maintain the management zone as a machine free zone. These overall retention levels are not intended to be applied on a cutblock by cutblock basis but rather reflect an average objective at the landscape level. The management of riparian areas will vary on a site by site basis and will need to consider the soil, terrain and windthrow hazard and the values that are to be managed in the zone.

A.3.14 Stream riparian reserves and management zones

Riparian reserve and riparian management zone width specifications for each stream class can be found in the *Riparian Management Area Guidebook* and are provided as background information in Table A-14.

Table A-14. Riparian reserve and riparian management zone criteria

	Reserve and management classification	Reserve zone width (metres)	Management zone width (metres)
Streams	S1 large rivers	0	100
	S1	50	20
	S2	30	20
	S3	20	20
	S4	0	30
	S5	0	30
	S6	0	20
Lakes	L1 A	200	50
	L1 A modified	50	200
	L1 B	50	50
	L1 C	30	70
	L1 D	10	90
	L1 E	10	40
	L3	0	30
Wetlands	W1	10	40
	W2	10	20
	W3	0	30
	W4	0	30
	W5	10	40

Data source and comments:

Streams and wetland guidelines from the *Forest Practices Code Riparian Management Area Guidebook* (December 1995) and lakeshore from the *Lake Classification and Lakeshore Management Guidebook*, Prince George Forest Region (September 1996).

A comprehensive stream inventory is not available for the Prince George TSA. To approximate a land base reduction needed to account for riparian reserve and management zones, a percentage area exclusion was estimated based on several MoF, MSRM and licensee studies. Information on stream riparian reserves comes from sample mapsheet studies by MoF staff in the Prince George Forest Region, mapping work for the McGregor Model Forest (TFL 30), and riparian studies for Lakeland Mills.

Table A-15. Riparian reserve and riparian management zone reductions

	Reserve zone impacts	Management zone impacts	
Ecosection	**Per cent (%) reduction to the timber harvesting land base**	**Basal area retention %**	**Per cent (%) reduction to the timber harvesting land base**
Hart Ranges, Caribou Mountains and Eastern Skeena Mountains	9	5-25	0.6
All other ecosections	3.5	5-25	0.4

A.3.15 Wildlife trees (WT) and tree patches (WTP)

The *Biodiversity Guidebook* describes two methods for providing the maintenance of stand structure over time. One method is wildlife trees while the other is wildlife tree patches. Forest district standards are outlined in Table A-16. On many cutblocks, riparian reserves and other previously excluded areas (deciduous or other non-commercial timber types) contribute to the wildlife tree patch objectives.

Table A-16. Forest district standards for retention in cutblocks — total forest area

Management zone	Reason for residual volume	Per cent (%) recommended by forest district standard application — gross forested land base
Fort St. James Forest District	Wildlife tree patches	8
Prince George Forest District	Wildlife tree patches	10
Vanderhoof Forest District	Wildlife tree patches	8

A sample of silviculture prescriptions from all districts in the Prince George TSA was reviewed to determine the approximate percentage of harvest blocks that were in wildlife tree patches. The review accounted for the overlap with riparian management areas, and other forested areas outside the timber harvesting land base. Wildlife tree retention considerations account for 131 877 hectares reduced from the timber harvesting land base.

Table A-17. Reductions to reflect wildlife tree retention in cutblocks — timber harvesting land base

Management zone	Reason for residual volume	Estimated per cent (%) reduction on timber harvesting land base
Prince George TSA	Wildlife tree patches	3.5

A.3.16 Accounting for cultural heritage resources

The *Forest Act* defines a cultural heritage resource as "... an object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community or an aboriginal people." There are several cultural heritage values within the Prince George TSA. They include archaeological sites, cultural modified trees, historical trails and areas of traditional use.

Culturally modified trees are emerging as an important cultural heritage resource. The impact to timber supply due to culturally modified trees is difficult to assess at this time, but will need to be monitored for subsequent timber supply review processes. Current procedures generally require recording the location, notifying the Ministry of Forests and notifying the appropriate First Nation. Consultation with the First Nation then determines the subsequent management strategy.

The Lheidli T'enneh First Nation has identified a sacred area in the vicinity of Ice Mountain in the Herrick Valley. A *Memorandum of Understanding* was signed in 1994 between the Ministry of Forests and the Lheidli T'enneh First Nation that provides a procedural framework for mutual cooperation with respect to forest management.

The Nuxalk-Carrier Grease Trail (Alexander Mackenzie Voyageur Route) and the Giscome Portage Heritage Trail have a buffer of 100 metres either side of the center line of the trails. Within this buffer timber harvesting is only permitted for control of insect infestations or disease or for salvaging timber damaged by fire, wind, and other natural disturbances.

Several areas are being considered as not generally available for timber harvesting in the Vanderhoof Forest District for cultural/heritage reasons. Kuyakuz Mountain, an area of approximately 1700 hectares, is reserved from harvesting pending the results of a *Traditional Use Study* with the Kluskus First Nation. Five pre-1846 aboriginal trails in the Vanderhoof Forest District are currently being managed: the Omineca Trail, the Cheslatta Trail, the Fraser Lake-Stuart Lake Pack Trail, the Ormond Creek Trail (from Ormond Lake Road to the South end of Ormond Lake), and the Messue Wagon Road (from the Blue Road to Euchiniko Lakes). A 100-metre 90% exclusion zone precludes harvesting on either side of these trails (200 metres total).

For other historical trails (e.g., Fort St. James to McLeod Lake, Telegraph Trail) the management intent is to maintain the integrity of the trail; no general harvesting restrictions apply.

Allowance for various cultural resource heritage issues results in a reduction to the timber harvesting land base of 2030 hectares.

Table A-18. Cultural heritage resource considerations

Identifying inventory variables (location descriptors)	Excluded area	Reason for exclusion
Nuxalk-Carrier Grease Trail (Alexander Mackenzie Voyageur Route)	Prince George — Vanderhoof — 200-metre corridor	Corridor is not available for timber harvesting.
Giscome Portage Heritage Trail	160 hectares (approximate area from the LRMP) — 200-metre corridor	Corridor is not available for timber harvesting.
Omineca Trail	90% exclusion of the 200-metre corridor (Vanderhoof District only)	Pre-1846 aboriginal trail; corridor is generally not available for timber harvesting.
Cheslatta Trail	90% exclusion of the 200-metre corridor	Pre-1846 aboriginal trail; corridor is generally not available for timber harvesting.
Fraser Lake-Stuart Lake Pack Trail (Vanderhoof Forest District)	90% exclusion of the 200-metre corridor	Pre-1846 aboriginal trail; corridor is generally not available for timber harvesting.
Ormond Creek Trail (from Ormond Lake Road to the South end of Ormond Lake)	90% exclusion of the 200-metre corridor	Pre-1846 aboriginal trail; corridor is generally not available for timber harvesting.
Messue Wagon Road (from the Blue Road to Euchiniko Lakes)	90% exclusion of the 200-metre corridor	Pre-1846 aboriginal trail; corridor is generally not available for timber harvesting.

A.3.17 Herrick local resource use plan (LRUP)

The Herrick Local Resource Use Plan (LRUP) was initiated at the request of the Assistant Deputy Minister, Operations of the Ministry of Forests due to old-growth values. The LRUP was approved by the Regional Manager of the Prince George Forest Region in November 1994. The LRUP has been endorsed by the Inter-agency Management Committee (IAMC) and the Prince George LRMP Working Group. The plan is currently being used as a basis for development plan approval.

One of the four types of zones in the Herrick LRUP was called 'reserve'. The primary objective of 'reserves' is to maintain a viable old-growth forest ecosystem.. Secondary objectives were to maintain wildlife habitat and recreation values. 4481 hectares are deducted from the timber harvesting land base for these old-growth reserves. Other management objectives associated with the Herrick LRMP are considered in this analysis and are discussed in other sections of the appendix.

A.3.18 Crown land plans

The Crown land plans for the Prince George, Vanderhoof and Robson Valley are not reflected in the ownership coverage in the forest inventory file. Staff from the in the Prince George Region BC Assets and Land Corporation (BCAL) provided the digital coverage of the plan. Many of the areas, although classified as crown provincial forest (ownership code 62N and C) should not contribute to the AAC because of the other uses they have been given in the plan. The following table indicates how the Crown land plan designations are treated in this analysis. This analysis considers the areas excluded from the timber harvesting land base available to provide forest cover requirements for other resources. 50 344 hectares of land base are removed due to Crown land plan designations not compatible with the commercial production of trees. The Prince George Forest District encompasses a small portion of the Robson Valley Crown land plan.

The Vanderhoof LRMP recommended further inventory be done to determine the total extent of lands with good agriculture potential. This inventory has now been completed and a further 8470 hectares of crown land has been identified that is not considered in this analysis. These lands have been designated as agriculture development areas (ADA) in the 2000 Vanderhoof Crown Land Plan and will not contribute to the long-term timber harvesting land base.

Table A-19. Prince George, Vanderhoof and Robson Valley Crown land plans (zone, modelling assumption)

Crown land plan zone	Management strategy
Agricultural development area (ADA)	Exclude from the timber harvesting land base
Settlement reserve area (SRA,IR,PRI, & MUNI)	Exclude from the timber harvesting land base
Recreation and conservation management area (RCMA)	Exclude from the timber harvesting land base
Wildlife habitat management area (WHMA)	Exclude from the timber harvesting land base
Sand and gravel reserve (SGR)	Include in the timber harvesting land base
Aggregate management area (AMA)	Include in the timber harvesting land base
Community pasture area (CPG)	Include in the timber harvesting land base
Natural environment area (NEA)	Exclude from the timber harvesting land base
Community leases and licences (CLL & LEA)	Exclude from the timber harvesting land base
Integrated forest management area and/or provincial forest (IFMA & PF))	Include in the timber harvesting land base

A.3.19 Isolated areas

A review of current practice was conducted in the Prince George TSA to examine areas with limited merchantable timber volume and high development costs. A *Delivered Wood Cost Report* (1994) and discussions with forest district and regional engineers and forest district operations staff were used to identify several areas unlikely to ever be harvested. These areas are listed in Table A-20. Even though these areas total over 20 000 hectares of land area much of it is not forested. 3645 hectares of potential timber harvesting land base is removed because it is considered to be isolated.

Table A-20. Exclusion of isolated areas

Identifying inventory variables (location descriptors)	Reason for exclusion
Planning cells identified in the Prince George Forest District: E020, E023, E089, E092, H029, H030, H032, H039, H040	Planning cells identified within the Prince George Forest District, as having small isolated islands of timber which are not likely to be harvested.
Planning cells identified in the Fort St. James Forest District: A002, A004, A008, A010, A024, A025, A029	Planning cells identified within the Fort St James Forest District, as having small isolated islands of timber which are not likely to be harvested.

A.3.20 Recently designated parks and ELUC areas

The Prince George, Fort St James and Vanderhoof Land and Resource Management Plans(LRMPs) have been signed-off since the last timber supply review. Most areas, proposed in these plans to be protected areas, have gone through the Order-in-Council process and have been officially designated as provincial parks or designated as protected under the *Environmental Land Use Act (ELUA)*. 170 786 hectares are removed from the timber harvesting land base for new parks. The gross area of these parks is larger but because they were removed well down the netdown sequence, the area reported above represents a fairly close approximation of the amount of potential timber harvesting land base.

A.3.21 McLeod Lake Band Treaty 8 Adhesion

The McLeod Lake Treaty 8 Adhesion area has been signed over to the McLeod Lake Band. This area is excluded from the TSA.

A.3.22 Not satisfactorily restocked (NSR) areas

Land classified in the Prince George TSA inventory file as type identity 4 or 9 is included in the timber harvesting land base if it has had a history of harvest, has had forest management done on it or if it is planted. These type identities (4 and 9) indicate not satisfactorily restocked (NSR) land base. Naturally occurring NSR areas (possibly wildfire origin) are allowed to go through all of the normal netdown steps and may or may not be excluded from the timber harvesting land base. Section A.4.7 indicates how NSR is distributed back into the timber harvesting land base.

A.3.23 Timber harvesting land base determination by forest district

Table A-21. Determination of the timber harvesting land base for the three forest districts within the Prince George TSA

	Total TSA (hectares)	Prince George Forest District (hectares)	Vanderhoof Forest District (hectares)	Fort St. James Forest District (hectares)
Total TSA area	7 508 190.72	2 999 487.03	1 384 454.65	3 124 249.05
Not managed by the Forest Service	423 328.12	224 879.57	166 118.71	32 329.85
New woodlots (rdarea3)	67 634.92	33 599.84	14 817.61	19 217.48
Non-forest (rdarea4)	1 689 954.36	525 484.68	144 004.39	1 020 465.29
Total productive forest managed by the forest service (Crown forest)	5 327 273.32	2 215 522.94	1 059 513.94	2 052 236.43
Non-commercial cover (brush)	80 614.90	55 989.57	1 715.49	22 909.84
Environmentally sensitive areas (ESAs)	446 919.91	202 694.47	40 289.46	203 935.98
Inoperable — physical (rdarea7)	15 986.05	13 906.44	561.76	1 517.85
Inoperable — economic (rdarea8)	281 025.84	103 680.56	19 707.51	157 637.77
Unmerchantable — mature (rdarea9)	317 075.99	130 378.72	54 094.89	132 602.37
Unmerchantable — immature (rdarea10)	45 635.94	16 839.28	7 268.38	21 528.28
Sustut LRUP preservation zone (rdarea11)	1 295.68	0.00	0.00	1 295.68
Caibou high (rdarea12)	113 871.18	94 467.66	0.00	19 403.53
Roads, trails and landings (rdarea13)	20 758.62	12 891.98	3 096.43	4 770.20
Lakeshore and wetland reserves and management zones	56 395.69	18 444.83	17 773.22	20 177.63
Stream riparian (rdarea18)	179 785.66	74 562.14	35 685.27	69 538.25
Wildlife tree patch (rdarea19)	131 876.78	52 208.36	30 776.25	48 892.17
Cultural heritage (rdarea20)	2 030.04	507.77	1 520.08	2.19
Herrick old-growth reserve (rdare20b)	4 480.59	4 480.59	0.00	0.00
Crown land plan (rdarea21)	50 343.76	45 324.26	5 019.50	0.00
Isolated high cost cells (rdarea22)	3 644.92	1 472.94	0.00	2 171.98
New protected areas	170 786.14	44 908.56	57 366.07	68 511.51
McLeod Lake Treaty-8 settlement (rdarea25)	16 600.93	16 600.93	0.00	0.00
Total current reductions	1 939 128.62	889 359.06	274 874.31	774 895.23
Current timber harvesting land base	3 388 144.70	1 326 163.88	784 639.63	1 277 341.20

A.4 Forest Management Assumptions

A.4.1 Utilization levels

The utilization levels define the maximum stump height, minimum top diameter (inside bark) and minimum diameter at breast height (dbh) by species and are used in the analysis to calculate merchantable volume. Table A-22 shows the standards and licence requirements currently in place for wood utilization in the Prince George TSA.

Table A-22. Utilization levels

Leading species	Utilization		
	Minimum dbh (cm)	**Maximum stump height (cm)**	**Minimum top dib (cm)**
All coniferous, except Pine supply blocks A, B, C, E, G, H	17.5	30	10
All coniferous, except Pine supply blocks D, F	15.0	30	10
Lodgepole pine except for below	12.5	30	10
Lodgepole pine supply block D — small diameter stands	10.5	15	10
Deciduous	17.5	30	10

Notes: Supply blocks A, B, and C are in the Fort St. James Forest District; supply blocks E, F, and G are in the Prince George Forest District; supply block D is in the Vanderhoof Forest District; and supply block F is in the southwest portion of the Prince George Forest District adjacent to the Vanderhoof Forest District.

A.4.2 Volume exclusions for mixed species stands

All species of merchantable size are charged to cut control, and therefore contribute to timber supply under current management.

A.4.3 Minimum harvestable age

A minimum harvestable age provide an estimate of the youngest age at which a stand can be before it may be harvested. Harvesting may occur in stands at the minimum age to meet forest level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large inter-decade changes in harvest levels). In many cases stands may not be harvested until well past the minimum age because other resource values takes precedence (e.g., requirements for the retention of older forest or when harvesting of old stands is desirable for forest health reasons). Table A-23. lists the minimum harvestable ages by species. These criteria apply to existing stands. The minimum harvestable ages reflect regional priority cutting ages as revised April 14, 1997.

A.4 Forest Management Assumptions

Table A-23. Minimum harvestable age criteria

Leading species	Minimum harvestable age (years)
Spruce	> 101
Pine	> 81
Fir	> 111
Balsam	> 121
Cedar	> 111
Hemlock	> 111
Deciduous	> 61

A.4.4 Silvicultural systems

The silvicultural systems currently employed in the Prince George TSA are indicated in Table A-24. The data was obtained from 5-year averages from the integrated silviculture information system (ISIS) and major licence silvicultural information system (MLSIS) reports for the Prince George and Vanderhoof Forest Districts. Figures for Fort St. James Forest District are based on estimates provided by the forest district operational staff because ISIS and MLSIS data was not current. In the previous analysis, alternative silviculture systems (i.e., alternative to clearcutting) were reported to comprise about 2% of the volume harvested in the Prince George TSA. For this analysis, because clearcutting is the predominant silvicultural system, all regeneration regimes will be based on that system, as reflected in Tables A-26. and A-27.

Table A-24. Percentage of total harvested area by silvicultural system

Silvicultural system	Fort St. James (%)	Prince George (%)	Vanderhoof (%)
Clearcutting	96	92	94
Partial cutting	2	5	6
Seed tree	1	2	
Shelterwood	1	1	
Total	100	100	100

A.4.5 Unsalvaged losses

The purpose of this section is to provide an estimate of average annual unsalvaged volume loss to insect and disease epidemics, fires, wind damage or other agents over the long term on the timber harvesting land base. The unsalvaged loss column reflects only volumes that will not be recovered or salvaged.

Insect losses were calculated by forest district staff using information from *the Pest Tracking System, Forest Health Notes*, data collected for previous timber supply analyses and forest health information from forest district records. It is notable that the total loss estimate for the Fort St. James Forest District is higher than that for the previous timber supply analysis. The main reason is that mountain pine beetle and balsam bark beetle infestations in the district have increased substantially in recent years. The current mountain pine beetle infestation (1999-2001) is not considered in the figures below. This infestation has occurred over the last few of years and the full extent of damage, and salvage, is not yet known.

Fire losses are from the *Fire Information Reporting System* — 5 year average (1992-1996) for the Fort St. James and the Prince George Forest Districts and 20-year average (1977-1996) for the Vanderhoof Forest District.

Wind losses were provided by the forest district staff based on forest health information.

Table A-25. Unsalvaged losses

Location	Cause of loss	Timber harvesting land base losses (m^3/year)	Annual salvage of losses (m^3/year)	Annual unsalvaged loss (m^3/year)
Fort St. James Forest District	Insects	329 000	150 000	179 000
	Fire	7 400	3 800	3 600
	Wind	27 000	19 000	8 000
Prince George Forest District	Insects	240 000	145 000	95 000
	Fire	100 600	61 300	39 300
	Wind	110 000	99 000	11 000
Vanderhoof Forest District	Insects	78 000	75 000	3 000
	Fire	17 300	7 400	9 900
	Wind	57 000	52 000	5 000
TSA Total	Insects	647 000	370 000	277 000
	Fire	125 300	72 500	52 800
	Wind	194 000	170 000	24 000
Total		966 300	612 500	353 800

A.4 Forest Management Assumptions

A.4.6 Basic silviculture and regeneration assumptions

The silviculture program reflects the mix of treatments carried out in the Prince George TSA. This level of activity assumes basic silviculture on most sites. Tables A-26. and A-27. show the proportion of each analysis unit to be treated under each silviculture regime and the expected average regeneration delay.

Recent plantations and future stands are grown on managed stand yield tables (MSYTs) produced using the British Columbia Forest Service table interpolation program for stand yields (TIPSY) growth and yield model. A MSYT may be built from a number of tables if more than one regeneration method is used within an analysis unit. When this is the case, tables have been produced for the different regeneration methods (each method x species combination) are then aggregated into one table. Managed stand volume tables are shown in Table A-32 at the end of this appendix.

Table A-26. Regeneration assumptions by analysis unit for the Fort St. James Forest District

Existing analysis unit number: species-site	Regenerated analysis unit(s)	Per cent to analysis unit (%)	Per cent planted (%)	Initial density (stems/hectare)	Operational adjustment factor (OAF) 1 (%)	Operational adjustment factor (OAF) 2 (%)	Regen delay (years)
1. Fir — all	Fir	60	100	1600	15	5	2
	Fir	5	0	5000	15	5	4
	Pine	30	100	1600	15	5	2
	Aspen	5	0	2500	15	5	4
4. Balsam — all	Spruce	80	100	1600	15	5	3
	Balsam	10	100	1600	15	5	3
	Aspen	10	0	2500	15	5	4
5. Spruce > 12	Spruce	80	100	1600	15	5	3
	Pine	10	100	1600	15	5	3
	Aspen	10	0	2500	15	5	4
6. Spruce < 12	Spruce	65	100	1600	15	5	3
	Balsam	10	100	1600	15	5	3
	Balsam	5	0	500	15	5	4
	Pine	15	100	1600	15	5	2
	Brush	5	0				
7. Pine — all	Pine	85	100	1600	15	5	2
	Pine	8	0	5000	15	5	3
	Aspen	7	0	2500	15	5	1
8. Aspen	Aspen	100	0	2500	15	5	1
9. ESSF (> 1 200 m elevation)	Spruce	70	100	1600	15	5	6
	Balsam	15	100	1600	15	5	6
	Balsam	5	0	500	15	5	6
	Brush	10	0				

Note: OAF 1 is a factor used to account for the effect on yields of small stocking gaps in the stand table (gaps exist as a result of rock outcrops, high water table and seedling mortality); while OAF 2 is a factor to account for other factors reducing growth or tree volume such as insects, disease, waste and breakage.

Table A-27. Regeneration assumptions by analysis unit for the Prince George and the Vanderhoof Forest Districts

Existing analysis unit number: species-site	Regenerated analysis unit(s)	Per cent to analysis unit (%)	Per cent planted (%)	Initial density (stems/ hectare)	Operational adjustment factor (OAF) 1 (%)	Operational adjustment factor (OAF) 2 (%)	Regen-delay (years)
1. Fir – all	Fir	90	100	1600	15	5	2
	Fir	10	0	5000	15	5	4
2. Cedar – all	Spruce	85	100	1600	15	5	3
	Fir	5	100	1600	15	5	3
	Hemlock	5	0	2500	15	5	4
	Cedar	5	0	2500	15	5	4
3. Hemlock – all	Spruce	95	100	1600	15	5	3
	Hemlock	5	0	2500	15	5	4
4. Balsam – all	Spruce	90	100	1600	15	5	3
	Balsam	10	100	1600	15	5	3
5. Spruce > 12	Spruce	90	100	1600	15	5	3
	Pine	10	100	1600	15	5	3
6. Spruce < 12	Spruce	75	100	1600	15	5	3
	Balsam	20	100	1600	15	5	3
	Balsam	5	0	500	15	5	4
7. Pine – all	Pine	95	100	1600	15	5	2
	Pine	5	0	5000	15	5	3
8. Aspen	Aspen	100	0	2500	15	5	1
9. ESSF (> 1200 m elevation)	Spruce	75	100	1600	15	5	6
	Balsam	20	100	1600	15	5	6
	Balsam	5	0	500	15	5	6

Note: OAF 1 is a factor used to account for the effect on yields of small stocking gaps in the stand table (gaps exist as a result of rock outcrops, high water table and seedling mortality); while OAF 2 is a factor to account for other factors reducing growth or tree volume such as insects, disease, waste and breakage.

Cedar and hemlock stands are shown to be regenerated mainly to planted (managed) spruce. Recent harvesting systems (2000/2001) have included more regeneration to cedar and hemlock.

A.4.7 Not satisfactorily restocked (NSR) areas

Land classified in the Prince George TSA FIP file as type identity 4 or 9 is included in the current timber harvesting land base if it has had a history of harvesting, has had forest management treatments applied to it or has been planted. These type identities indicate not satisfactorily restocked land base. The purpose of this section is to identify the estimated rate at which the NSR area will be restocked.

Table A-28. Treatment of not satisfactorily restocked (NSR) areas

		NSR area restocked (hectares)			
		Regenerated to natural stands (VDYP)	**Regenerated to managed stands (TIPSY)**		
Analysis unit number	**Species**	**Restocked in 1 to 10 years**	**Restocked now**	**Restocked in 1 to 10 years**	**Restocked in 11 to 20 years**
Prince George Forest District					
1	Fir	89	197	46	0
2	Cedar	0	0	0	0
3	Hemlock	0	0	0	0
4	Balsam	1 842	279	143	71
5	Spruce SI ≥ 12	6 219	2 430	644	51
6	Spruce SI < 12	76	315	29	0
7	Pine	4 176	24 760	795	17 361
8	Deciduous	0	0	0	0
9	ESSF stands	373	24	85	5
All analysis units	All	12 775	28 005	1 742	17 488
Vanderhoof Forest District					
1	Fir	0	6	0	0
2	Cedar	0	0	0	0
3	Hemlock	0	0	0	0
4	Balsam	464	0	3	0
5	Spruce SI ≥ 12	985	188	27	1
6	Spruce SI < 12	44	6	0	0
7	Pine	3 517	17 481	232	6 334
8	Deciduous	0	0	0	0
9	ESSF stands	264	306	39	14
All analysis units	All	5 274	17 987	301	6 349
Fort St. James Forest District					
1	Fir	62	0	0	0
2	Cedar	0	0	0	0
3	Hemlock	0	0	0	0
4	Balsam	1 314	655	14	22
5	Spruce SI ≥ 12	2 293	2 071	210	32
6	Spruce SI < 12	150	552	34	0
7	Pine	4 228	23 541	29	3 530
8	Deciduous	0	0	0	0
9	ESSF stands	127	120	0	0
All analysis units	All	8 174	26 939	287	3 584

A.4.8 Immature plantation history

For this analysis all stands harvested after 1987 were assigned to a managed stand yield curve. These stands have a history of density control and stand tending and are considered managed stands.

A.4.9 Harvest scheduling priorities

Generally, older available stands are favoured for harvesting when all other objectives have been met.

A.4.10 Forest cover requirements — resource management zones other than biodiversity requirements

Forest cover requirements may be examined at a number of different levels. These may be considered as layers in geographic information system (GIS) terminology. One possible layer may be landscape units, another may be wildlife areas, while another may be resource emphasis. With the requirement to retain different forest characteristics across the landscape, it is important to identify how non-contributing forest (forest which does not contribute to the timber harvesting land base) may be considered in the forest cover requirements (i.e., maximum allowable disturbance or minimum area retention). For the Prince George TSA, for the base case, excluded forest contributes to forest cover requirements for all zones or groups.

The following forest cover requirements are applied to each resource emphasis group or zone.

Table A-29. Forest cover requirements — other than biodiversity requirements

Zone or group	Maximum allowable disturbance (% area)	Green-up height (metres)	Minimum retained area (%)	Minimum age for retention (years)	Source of prescription
VQO — retention	4	5	N/A		Draft procedures for factoring visual resources into timber supply analyses, January, 1998.
VQO — partial retention	11	5	N/A		
VQO — modification	21	5	N/A		
VQO — maximum modification	33	5	N/A		
Vanderhoof LRMP — special	20	3	N/A		Vanderhoof staff
Caribou — medium (Prince George Forest District)	33	3	33	160	MELP/MoF
Caribou — corridors (Prince George Forest District)	20	3	20	100	MELP/MoF
Aleza Lake Research Forest	25	3	25	110	Management plan
Herrick FENs	25	3	25	120	MELP
Other integrated management areas	25	3	N/A		

A.4.11 Forest cover requirements — landscape-level biodiversity

Landscape units in the Prince George TSA have not had their biodiversity emphasis formally approved. For the base case, landscape unit (LU) biodiversity assignment was assumed to be 45% low, 45% intermediate and 10% high. This is achieved by averaging the 10, 45, 45 requirements and applying this average to each landscape unit. In keeping with the *Deputy Minister's letter* of August 27, 1997, and the *Landscape Unit Planning Guide* of March 1999, landscape units assigned a low BEO have three rotations to meet the old-forest retention requirements. The old-seral objective in the low contribution category was phased in by requiring one-third of the target to be met in the first 70 years, two-thirds in years 71 to 140 and the full requirement by year 141. Retention of old-growth forest in every landscape unit and natural disturbance type (NDT) is a requirement under the *Forest Practices Code*. Table A-30. summarizes the percentage of old forest required for each NDT modelled in this analysis. Seral stage requirements were applied at the level of the: forest district, landscape unit, and natural disturbance type. Requirements for retention of mature forest and constraints on early-seral forest have been considered in the sensitivity analysis. The base case also incorporated the mature plus old requirements in NDT with no downward impact on harvest flow.

Table A-30. Old and mature plus old seral requirements for landscape unit and natural disturbance type (NDT) used in the base case.

		Old seral stage minimum retention area by year (%)				**Mature plus old seral stage (NDT3 only)**	
NDT	**Biogeo**	**Years 1-70**	**Years 71-140**	**Years 141+**	**Minimum age (years)**	**Minimum retention area (%)**	**Minimum age (years)**
1	ESSF	14.2	17.1	19.9	250	N/A	N/A
1	ICH	9.7	11.7	13.6	250	N/A	N/A
2	ESSF	6.7	8.1	9.4	250	N/A	N/A
2	ICH	6.7	8.1	9.4	250	N/A	N/A
2	SBS	6.7	8.1	9.4	250	N/A	n/a
2	SWB	6.7	8.1	9.4	250	N/A	N/A
3	BWBS (decid.)	9.7	11.7	13.6	100	19.6	80
3	BWBS (conif.)	8.2	9.9	11.5	140	19.6	100
3	SBPS	5.2	6.3	7.3	140	13.8	100
3	SBS	8.2	9.9	11.5	140	18.7	100
5	AT	6.7	8.1	9.4	250	N/A	N/A

A.5 Volume Estimates for Existing Stands

The variable density yield projection (VDYP) model, version 6.5a developed and supported by the British Columbia Ministry of Forests, Resources Inventory Branch, was used to estimate timber volumes for existing natural stands. Table A-31. shows the volume estimates by analysis unit for existing natural stands.

Table A-31. Timber volume tables for existing natural stands (cubic metres per hectare)

Prince George Forest District							
Existing natural stands							
	1001 Fir	1004 Balsam	1005 Spruce (SI ≥ 12)	1006 Spruce (SI < 12)	1007 Pine	1008 Deciduous	1009 High elevation ESSF (balsam and spruce > 1200 m)
Age	Volume (m3/hectare)						
10	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
30	2	1	0	0	18	0.57	0
40	27	10	4	0	67	16.4	1
50	65	29	30	0	114	51.01	9
60	103	54	75	3	156	85.72	26
70	138	83	121	15	193	119.02	51
80	171	107	163	38	226	146.7	77
90	201	130	200	64	256	172.69	101
100	229	151	233	90	284	193.67	125
110	254	171	261	114	309	209.2	146
120	277	189	286	137	332	220.69	166
130	298	207	308	158	354	228.48	185
140	316	223	328	178	368	236.01	203
150	332	239	344	196	379	242.48	219
160	345	254	359	213	387	244.63	234
170	358	268	371	228	392	246.32	248
180	369	282	382	242	394	247.57	261
190	379	295	391	255	392	248.43	274
200	389	307	400	267	394	249.52	285
210	398	319	408	278	397	250.54	296
220	407	331	415	288	400	251.5	306
230	415	342	422	298	403	252.38	315
240	423	352	428	307	405	253.19	324
250	431	363	433	315	408	253.93	333
260	432	364	437	320	410	254.45	336
270	433	366	441	325	412	254.92	339
280	434	368	444	330	414	255.33	342
290	435	369	446	334	416	255.69	345
300	435	370	449	338	417	256.01	348
310	436	372	451	342	419	256.28	350
320	437	373	453	345	420	256.52	352
330	437	374	454	348	421	256.71	354
340	437	375	456	351	422	256.87	356
350	438	376	457	353	423	256.99	357

(continued)

A.5 Volume Estimates for Existing Stands

Table A-31. Timber volume tables for existing natural stands (cubic metres per hectare)

Vanderhoof Forest District

Existing natural stands

	2001 Fir	2004 Balsam	2005 Spruce (SI ≥ 12)	2006 Spruce (SI < 12)	2007 Pine	2008 Deciduous	2009 High elevation ESSF (balsam and spruce > 1200 m)	2017 Small pine
Age	**Volume (m3/hectare)**							
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	1	3	0	0	3	0.13	0	0
40	27	15	3	0	29	11.56	1	12
50	63	35	20	0	67	42.93	5	39
60	97	59	59	3	103	75.79	14	72
70	127	88	104	19	135	108.3	29	104
80	155	112	146	45	165	136.34	48	133
90	179	134	184	74	192	161.61	69	160
100	202	153	219	103	218	182.22	89	185
110	222	172	250	130	241	197.46	110	207
120	241	188	278	156	263	208.45	129	228
130	258	206	303	181	283	215.85	149	246
140	273	222	325	204	297	223.21	167	263
150	286	238	343	223	308	229.51	183	278
160	297	252	358	241	316	231.52	198	291
170	307	266	371	257	322	233.05	212	303
180	316	278	382	270	324	234.15	224	313
190	323	290	390	282	323	234.85	236	323
200	331	302	399	294	326	235.79	247	331
210	339	313	408	305	329	236.69	257	339
220	346	324	415	315	332	237.52	267	345
230	352	334	422	325	334	238.28	277	351
240	359	344	428	334	337	238.98	286	357
250	365	354	434	342	339	239.6	294	362
260	366	356	438	349	342	240.14	299	366
270	366	358	443	355	344	240.62	304	370
280	367	361	447	361	346	241.04	308	374
290	367	363	450	367	347	241.4	312	378
300	368	365	454	372	349	241.73	316	380
310	368	366	457	377	350	242	320	383
320	368	368	459	381	352	242.22	323	386
330	369	370	462	385	353	242.41	326	388
340	369	371	464	389	353	242.55	329	391
350	369	373	466	392	354	242.66	332	393

(continued)

A.5 Volume Estimates for Existing Stands

Table A-31. Timber volume tables for existing natural stands (cubic metres per hectare) (concluded)

	Fort St. James Forest District						
	Existing natural stands						
	3001 Fir	3004 Balsam	3005 Spruce (SI ≥ 12)	3006 Spruce (SI < 12)	3007 Pine	3008 Deciduous	3009 High elevation ESSF (balsam and spruce > 1200 m)
Age	Volume (m3/hectare)						
10	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
30	1	0	0	0	13	0.54	0
40	18	4	3	0	54	14.59	1
50	50	17	25	0	98	49	6
60	83	35	66	2	137	83.48	18
70	115	59	113	11	173	116.39	37
80	146	79	155	30	204	143.7	56
90	174	98	193	52	233	169.29	73
100	201	115	226	75	260	190.14	90
110	225	132	256	98	284	205.62	106
120	247	148	283	120	306	217.17	121
130	267	164	307	141	327	225.24	136
140	284	179	328	161	341	233.06	150
150	300	193	346	179	352	239.8	164
160	313	206	361	195	360	242.18	176
170	324	219	373	210	365	244.06	189
180	335	231	384	224	367	245.5	200
190	345	243	393	236	366	246.51	211
200	354	254	402	248	369	247.75	222
210	364	265	411	259	371	248.93	232
220	372	276	418	270	374	250.01	242
230	380	286	425	279	377	251.02	252
240	388	296	431	288	379	251.94	261
250	395	305	436	297	382	252.79	270
260	396	307	441	303	384	253.36	271
270	397	308	444	308	386	253.87	273
280	397	309	448	314	388	254.31	274
290	398	310	451	319	390	254.7	275
300	398	311	453	323	391	255.05	276
310	399	311	456	327	393	255.35	277
320	399	312	458	331	394	255.61	278
330	399	313	460	335	395	255.82	279
340	399	314	462	338	396	256	280
350	399	314	463	341	397	256.13	281

A.6 Volume Estimates for Managed Stands

Table A-32. Timber volume tables for managed stands (cubic metres per hectare)

Prince George Forest District						
	Managed stands					
	1101 Fir	1104 Balsam	1105 Spruce (SI ≥ 12)	1106 Spruce (SI < 12)	1107 Pine	1109 High elevation ESSF (balsam and spruce > 1200 m)
Age	Volume (m3/hectare)					
10	0	0	0	0	0	0
20	0	0	0	0	2	0
30	1	0	3	0	43	0
40	8	0	12	0	117	0
50	35	2	56	0	184	0
60	77	26	122	1	238	8
70	128	73	192	10	283	34
80	170	128	251	35	318	72
90	207	179	311	70	342	119
100	245	223	359	109	363	164
110	279	267	392	151	382	202
120	308	312	419	184	397	239
130	338	347	437	217	406	275
140	364	377	451	249	417	313
150	387	397	462	281	426	340
160	409	414	472	314	433	364
170	428	425	478	336	440	381
180	443	436	485	357	439	397
190	457	447	487	373	441	410
200	470	452	487	386	440	417
210	482	457	484	397	441	427
220	495	465	483	405	441	432
230	504	467	482	414	441	438
240	513	469	482	421	442	443
250	519	475	480	425	440	449
260	527	475	477	430	442	451
270	531	476	475	433	440	452
280	537	472	475	436	442	454
290	541	470	472	442	442	456
300	542	470	472	442	442	456
310	542	470	472	442	442	456
320	542	470	472	442	442	456
330	542	470	472	442	442	456
340	542	470	472	442	442	456
350	542	470	472	442	442	456

(continued)

A.6 Volume Estimates for Managed Stands

Table A-32. Timber volume tables for managed stands (cubic metres per hectare)

	Vanderhoof Forest District						
	Managed stands						
	2101 Fir	2104 Balsam	2105 Spruce (SI ≥ 12)	2106 Spruce (SI < 12)	2107 Pine	2109 High elevation ESSF (balsam and spruce > 1200 m)	2117 Small pine
Age	Volume (m3/hectare)						
10	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
30	0	0	2	0	10	0	10
40	12	1	10	0	48	0	48
50	37	6	45	0	98	0	98
60	71	31	104	5	145	1	145
70	111	76	168	23	185	10	185
80	150	127	223	54	217	32	217
90	183	179	273	92	244	63	244
100	214	221	324	131	266	99	266
110	243	262	364	171	285	137	285
120	272	302	392	206	303	173	303
130	296	340	413	237	314	203	314
140	317	370	428	267	323	231	323
150	339	393	443	300	331	260	331
160	360	408	452	327	338	288	338
170	377	421	459	350	343	317	343
180	394	432	468	371	347	337	347
190	409	442	472	383	350	357	350
200	423	448	477	395	355	373	355
210	431	454	480	405	355	383	355
220	440	457	480	412	361	394	361
230	449	464	477	419	363	403	363
240	458	465	474	425	365	410	365
250	464	467	473	431	367	415	367
260	473	471	472	434	370	420	370
270	479	472	472	438	366	423	366
280	482	472	467	441	361	428	361
290	487	470	465	444	359	430	359
300	487	470	466	444	359	430	359
310	487	470	466	444	359	430	359
320	487	470	466	444	359	430	359
330	487	470	466	444	359	430	359
340	487	470	466	444	359	430	359
350	487	470	466	444	359	430	359

(continued)

A.6 Volume Estimates for Managed Stands

Table A-32. Timber volume tables for managed stands (cubic metres per hectare) (concluded)

Fort St. James Forest District						
	Managed stands					
	3101 Fir	3104 Balsam	3105 Spruce (SI ≥ 12)	3106 Spruce (SI < 12)	3107 Pine	3109 High elevation ESSF (balsam and spruce > 1200 m)
Age	Volume (m3/hectare)					
10	0	0	0	0	0	0
20	0	0	0	0	1	0
30	9	0	2	0	24	0
40	30	0	10	0	82	0
50	62	0	46	2	143	0
60	105	3	105	5	193	1
70	149	22	169	11	233	6
80	189	58	223	28	267	24
90	223	97	274	55	297	52
100	251	140	323	86	316	84
110	278	177	357	119	331	119
120	302	211	381	150	345	152
130	324	241	397	177	356	182
140	344	275	413	203	365	207
150	362	305	424	228	375	236
160	377	328	433	253	380	263
170	391	346	439	278	385	288
180	403	360	444	296	390	308
190	414	371	449	313	392	324
200	422	381	450	326	397	336
210	431	388	449	336	400	348
220	439	395	448	345	402	356
230	444	401	446	353	404	364
240	449	405	446	359	403	369
250	456	408	444	365	401	375
260	460	412	442	370	396	381
270	461	415	440	372	393	384
280	465	416	439	377	389	387
290	466	419	437	378	387	390
300	466	419	437	379	387	390
310	466	419	437	379	387	390
320	466	419	437	379	387	390
330	466	419	437	379	387	390
340	466	419	437	379	387	390
350	466	419	437	379	387	390

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The socio-economic analysis identifies employment and income impacts, changes in government revenues and community impacts at various harvest levels and times in the future. Some of the assumptions used in the analysis are as follows:

Employment multipliers — these multipliers are used to estimate indirect and induced employment impacts of a change in direct industry activity. Employment multipliers are calculated based on analytical assumptions and data collected at a specific time. Consequently, the multipliers reflect industry and employment conditions at that time and may not accurately reflect future industry conditions. While generally sound indicators when based on fairly recent information, older multipliers can be dated and may not reflect industry conditions at the time of analysis. In any impact analysis, the information should be considered as indicators of size of change.

Employment coefficients — employment impacts associated with future harvest levels are calculated using employment coefficients (person-years per 1000 cubic metres). This approach assumes that the industry structure will be the same in future as it is today. While reasonably accurate in the short term, employment coefficients may change in future due to changing market conditions or production technologies, for example.

Timing of impacts — employment impacts are shown to occur simultaneously with a change in the harvest level. While fairly accurate for the harvesting sub-sector, this may not be the case for the processing and silviculture sub-sectors of the forest industry. Also, indirect and induced impacts will likely occur over a longer period, as business and consumer spending levels adjust to changes in harvest levels.

Processing thresholds — processing job impacts are unlikely to occur in direct proportion to harvest changes (i.e., a 10% harvest reduction may not lead to a 10% processing employment reduction). Impacts are more likely to occur step-wise related to processing thresholds. A processing threshold is the level of a mill's timber supply where, when reached, will cause a mill to either lay off a shift or shut down the mill, temporarily or permanently. Accurately predicting a mill's threshold level is impossible. As a result, the analysis may overestimate processing impacts if a mill continues to operate the same number of shifts, but perhaps at lower production levels. Alternatively, it could underestimate impacts if a mill were to eliminate a shift. Over the medium to long term the impact figures should be reasonably accurate, however.

Government expenditures — provincial government expenditures are more related to population levels than to industry activity. As such, expenditures on education, health care and other government services are assumed to remain unchanged despite harvest changes and any subsequent change in government revenues. However, public expenditures would likely change if community population levels change sufficiently. This shift would amplify the community impacts of forestry job losses or gains.

Proportional harvest reductions — harvest reductions are assumed to be spread proportionately among all licensees and all forms of tenure.

B.2 Economic Impact Analysis Methodology

Data sources

Data for the socio-economic analysis were obtained from several sources. Harvest volume and stumpage data are from the Ministry of Forests. Timber flow and employment data are from responses to questionnaires that were sent to licensees, operators and processing facilities in the TSA. Other general economic data are from British Columbia Statistics, Statistics Canada and local communities.

Person-year of employment

The unit of measurement for employment is a person-year. A person-year of employment is defined as a full-time job, which lasts at least 180 days per year. Part-time jobs were converted to equivalent full-time person-years of employment. To estimate employment and income impacts associated with changes in TSA timber harvest levels, the forestry sector was divided into three sub-sectors:

1. harvesting;
2. silviculture; and
3. timber processing.

Estimating employment and income impacts involves several steps. First, the current activity in each of the three sub-sectors was assessed. Then, indirect and induced employment and employment income impacts were estimated, using data from British Columbia Statistics. Next, employment coefficients were calculated and applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues and industry taxes, were also calculated using Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including harvesting, log transport, log salvage, planning and administration functions. The employment multipliers used in this analysis define road building and maintenance work as indirect rather than direct employment. Including this employment in direct estimates would result in double counting.

Data on employment, place of residence and timber flows were obtained through a survey of licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of resident versus non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

1. TSA direct employment in harvesting consists of employees who are engaged in harvesting and related activities within the TSA and who reside in communities within the TSA; and
2. Provincial direct employment in harvesting consists of employees who are engaged in harvesting, as above, plus those workers who reside outside the TSA, but who come to the TSA to work in harvesting and harvesting-related activities.

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients per 1000 cubic metres. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilization, pruning and spacing. Silviculture employment data were collected from the Ministry of Forests and licensees whose tenures require post-harvest silviculture work. Most silviculture work is seasonal and silviculture employees usually only work part-time during the year. Because of this, silviculture jobs were converted into equivalent full-time person-years of employment. Respondents were also asked to estimate the percentage of their silviculture employees who resided within the TSA and outside the TSA.

As with the harvesting sub-sector, two estimates of direct employment in silviculture were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for silviculture employment in the same manner as the employment coefficients for harvest employment.

Employment — timber processing

Information about employment, production and sources of timber was gathered from TSA mills. Information was also gathered as to whether timber harvested from the TSA was processed within or outside the TSA. This information indicates the degree of dependence the mills have on timber harvested within the TSA. To estimate the share of processing employment supported by TSA timber, mill employment was prorated by the relative contribution of timber from the TSA to a mill's total timber requirement. For example, if 80% of a plant's timber requirement was supplied by the harvest from the TSA, then 80% of the employment in the plant would be attributable to the TSA harvest.

Employment figures were also adjusted to reflect the residences of workers: those who lived within the TSA and those who lived outside the TSA. Employment in timber processing that is supported by chip by-products from milling operations was also estimated similarly.

As with the harvesting sub-sector, two estimates of direct employment in timber processing were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for timber processing employment in the same manner as the employment coefficients for harvest employment.

Indirect and induced employment estimates

Indirect employees associated with the forestry sector are those who supply goods and services to firms directly engaged in the basic forestry sector (for example, those who provide road maintenance services, fuel and office equipment and products). Induced employment consists of those who supply goods and services purchased by employees who are directly and indirectly engaged in the industry (for example, those who work in retail outlets). Indirect and induced employment figures were calculated using TSA and provincial employment multipliers (see Table B-1).

Two sets of employment multipliers were used for this report: migration multipliers and no-migration multipliers. The migration multipliers assume that displaced workers will leave the region, reducing total income in the region by their full wage. The no-migration multipliers assume that displaced workers remain in the area, at least in the short term, and unemployment and other social safety net payments temporarily offset some of the income loss. Using the no-migration multipliers diminishes the induced impacts associated with a change in direct employment.

B.2 Economic Impact Analysis Methodology

The TSA and provincial employment multipliers used in the Prince George TSA analysis are shown in Table B-1. Multipliers are available for each forest district. To determine the TSA impact, the Prince George Forest District multipliers were used, based on the assumption that an average TSA multiplier would not exceed the highest multipliers available but could be as large as the highest available.

Table B-1. Total employment multipliers

Forest sub-sector	TSA migration multiplier	TSA no-migration multiplier	Provincial interior migration multiplier	Provincial interior no-migration multiplier
Prince George Forest District				
Harvesting	1.65	1.14	2.14	1.80
Solid wood processing	1.67	1.40	2.29	1.93
Pulp	2.17	1.82	3.02	2.48
Fort St. James Forest District				
Harvesting	1.28	1.16	2.14	1.80
Solid wood processing	1.36	1.20	2.29	1.93
Pulp	N/A	N/A	N/A	N/A
Vanderhoof Forest District				
Harvesting	1.34	1.21	2.14	1.80
Solid wood processing	1.45	1.29	2.29	1.93
Pulp	NA	NA	NA	NA

N/A = not applicable.

Sources: Horne, G., R. Riley, L. Ransom, and S. Kosempel. 1996. A provincial impact estimation procedure for the British Columbia forest sector. British Columbia Ministry of Finance and Corporate Relations, Victoria, British Columbia. 40 p.

British Columbia Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables. Victoria, British Columbia.

Employment estimates of alternative timber supply levels

To estimate employment generated by alternative timber supplies, the forecast harvest level is multiplied by the calculated employment coefficients. Note that employment coefficients are based on current industry productivity, harvest practices and forest management assumptions and will not likely reflect industry operating conditions in the future. Therefore, the employment estimates should be viewed as indicators of the size of change rather than as precise estimates of changes in employment levels.

B.2 Economic Impact Analysis Methodology

Estimates of employment income

Employment income was calculated using average income estimates for workers in the forest industry. Income data are from Statistics Canada annual estimates of employment, earnings and hours. From 1997 to 1999, the average pre-tax annual income (less benefits) for sub-sectors of the forestry sector associated with the Prince George TSA was about $46,800 for logging and forestry services; $46,200 for solid wood manufacturing; and $55,900 for the pulp and paper sector. The weighted average annual income for direct forestry workers in the Prince George TSA was $46,690. The average annual income for indirect and induced workers averaged about $30,300. This figure is based on data for all service-producing industries from the Statistics Canada Labour Force Survey estimates for British Columbia. Income taxes were calculated based on marginal tax rates of 23–28% with one-third of the total income tax accruing to the province.

Provincial government revenues

Except for stumpage, royalty and rents, which are specific to the TSA, provincial government revenue impacts were estimated by using industry averages. Revenues per 1000 cubic metres of harvest, expressed as dollars per 1000 cubic metres, were calculated and applied to the harvest levels in the base case forecast in a manner similar to how employment impacts were estimated. Table B-2. summarizes provincial government revenue estimates.

Table B-2. Estimates of provincial government revenue — Prince George TSA

Source of revenue	Average revenue 1997–1999 ($1998 millions)	Revenue ($/'000s m^3)
Stumpage, rents and royalties[a]	329.7	37,086
Industry taxes[b]	80.0	9,037
Provincial income tax[c]	48.8	5,513
Total government revenues	458.5	51,768

(a) Ministry of Forests.

(b) PricewaterhouseCoopers.

(c) Based on marginal tax rates from Revenue Canada.